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Grenade warfare

Adrien Gay

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GRENADE WARFARE

By CAPTAIN ADRIEN GAY

$1.

FOURTH FRENCH EDITION
FIRST AMERICAN EDITION
REVISED

1918

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Grenade Warfare

School of the Grenadier

A Guide for

Hand Bombers and Rifle Grenadiers

FOURTH FRENCH EDITION

FIRST AMERICAN TRANSLATION

Revised

BY

CAPTAIN ADRIEN GAY

2nd Zouaves Regiment, French Army
Knight of the Legion of Honor, Wearing the War Cross
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E. W. ALLEN & COMPANY
Publishers
ATLANTA, GA., U. S. A.
1918

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The Leader

of a Bomber's Group

has an important duty.

Every soldier under command

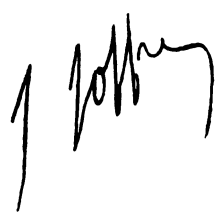
has part of the duty

and this small unit must have

an exceptionally high morale

in order that it might be a selected group

—G. Q. G. August, 18, 1918



Marshall of France

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Dedicated to the Officers of the National Guard and National Army, Camp Wheeler and Camp Gordon Georgia

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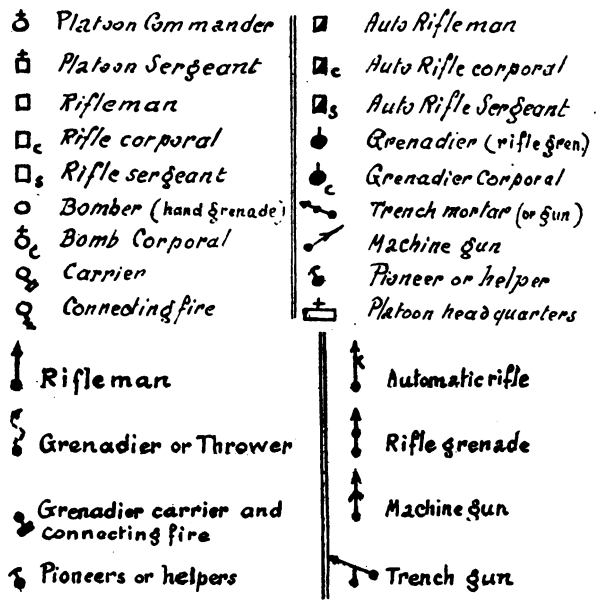

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GRENADE WARFARE

SCHOOL FOR THE GRENADIER
Guide for Hand Bombers and Rifle Grenadiers

HISTORICAL-EFFICIENCY

This war has convinced us that when fighting men were placed in conditions where direct fire with flat trajectory of our strong powerful modern weapons was insufficient, they merely returned to the ancient use of war weapons and machinery.

For this reason, grenades which had been abandoned for more than a century, have come back into use in trench warfare as well as the prehistorical instruments of throwing: Catapults, slings, onagers, etc., known to be very ancient, since the Bible says that eight centuries before Christ, 2700 years ago, the walls of Jerusalem had been attacked by Ozias with machines constructed by a very clever engineer for the purpose of throwing large stones and arrows.

All authors of the Fifteenth century and the beginning of the sixteenth century in their writings mentioned a weapon of war, described as a flying mortar which was used in many sieges at that time.

When describing the siege of Rouen, by the English, under Charles the VI, (Fourteenth Century), the French chronicle Montrelet mentioned these flying mortars as being used in this siege by the forces on the defensive. It is supposed that grenades originated from bombs, fire-pots or some similar machines, but of course that supposition cannot be taken as absolutely correct, because grenades were heard of more than 50 years before bombs.

The name grenade was given to this weapon, owing to its resemblance to a pomegrenate, fruit. This fruit is composed of small grenades, red in color, and this corresponds to the shot in the grenade in use now. It was given its name

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officially under the reign of Frances the I, King of France, during the years 1515 and 1548, at which time the grenade was used quite commonly but under different denominations.

*
* *

The grenade also appeared in the siege of Arles in 1536.

The French historian, du Bellay, in telling of the great preparation of the French in Provence, to resist the attacks of the Spanish (under Emperor Charles-Quint) gives descriptions of great quantities of what is now known as grenades, being sent to Arles.

Also in 1562 during a civil and religious war in France, Conte Charles de Laroche Foucauld was killed by a grenade falling and exploding near him, while he was observing the position of the enemy.

Again at Ostende during the year 1602 the Spaniards threw 58,000 grenades and the defenders used 20,000. This is counted as a considerable number for that epoch, for the reason that, industries for manufacture, were not developed at that time. This proves they were considered very important as a weapon in that war, since fighting was at short distances.

In 1667 when the Swedes were defending Stettin they use hand grenades made out of wood and a machine for throwing it. The machine was placed at the extremity of a flexible stick and thrown with the hand a great distance.

Under Louis the XIV. they used grenades and mortars with casts made up of small tubes the center one throwing a large bomb and the smaller tubes throwing smaller ones. This cast was called a young partridge, for the flying of the projectile resembled a partridge accompanied by its little ones in flight.

*
* *

In a different epoch the grenades were made of glass cortoons, bronze or cast iron. They generally had the form of a sphere filled with powder their weight being from 2 to 6 pounds and the diameter from 8 to 14 inches. They were thrown by hand, also in firepots, shells of fireballs, balloons, and barrels making a noise like thunder. The Germans at that time were throwing grenades with the use of a shovel and an object similar to a large spoon. The Spanish use especially shovel or spoons for rampart or breach defense and to prevent from passing a ditch.

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The men were placed in two ranks. The front rank was to carry the shovel and the rear rank to light the grenade, balance the spoon and throw the projectile.

Vauban perfected this grenade and for this reason he thought it was more effective than the bomb and would kill and wound a greater number.

In the seventeenth century in the year 1676 the grenade as used in preference. Louis the XIV organized in his guard, one company of grenadiers he being the captain, showing he realized the importance of grenades.

Towards the end of the seventeenth century an increase in rapidity and range of guns was realized. Especially at the battle of Steinkergue in 1690, epoch when running fires was used very extensively, that hand grenades began to be abandoned.

This abandonment came gradually after the peace of Versailles. Bombers were no longer given instructions in the throwing of grenades. Companies and Regiments of Bombers organized previous to 1670 and which were composed of the selected troops of the Royal Guards and of the Guard of Napoleon the I momentarily disappeared after the French Revolution in 1848 and definitely after the fall of the second French Empire.

Only sappers of the Engineer corps and the Marines, who were called upon to fight at short distances while boarding ships and in approach work of besieges were exercised in throwing grenades.

In the British Army a number of men were specialized in this kind of fighting.

The grenades and trenches with barbed wire reappeared at Port Arthur, where thousands of grenades, were thrown by both the Russians and Japanese.

Also in the Balkan War great quantities of hand grenades were used in the mountains, by both the Bulgarians and Turks at Tchataldja and Andrinople.

The Germans always kept close watch in all these wars, use of trenches, barbed wire, heavy artillery and the dreadful effects of the grenade did not escape their notice. The German inventors perfected and completed all methods of combats used during these wars. By the experience they gained when the war broke out in 1914 the Germans possessed immense quantities of munitions and assortments of all kinds of apparatus for

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throwing bombs short and long distances. Their reserves gave them a great superiority in the first days of trench warfare.

The first grenades were thrown on French troops at the Battle of the Marne, the end of August 1914. A big stock of grenades were found by the French, in the region of Vitry le Francois. They were marked made in 1913. Their rifle grenades were manufactured at the same time.

Improvised grenades were manufactured by the men, but soon after, through the genius of French and British inventors they had the German inventions surpassed. They will be put to even greater perfection by the efforts and cleverness of the American inventors. When the war started, the Allies were taken by surprise and to return enemy fire used a petard of melinite. Tins of preserves filled with cheddite and dynamite, nails and bullets which they used in throwing at the Teutons. It was only in February, 1915, that the English and French factories started to make hand grenades similar to the enemies mortars. It was in Mesnil-les-Hurlus in Champaign, February 15, 1915, that the first volley of grenades was thrown, falling in a German firing trench listening post, which provoked a very disagreeable surprise to the Germans. They then learned that the French hand grenades, were the same or better than theirs, and grenade bombers, reappeared on the battlefield. In each army one sees several units of hand bombers and Rifle Grenadiers.

* * *

The use of the grenade is found in every phase of battle. This is why its study constitutes a special military art. Under the conditions of this war is was very imperative that the grenade reappear. From all indications trench warfare is going to last a long time and we will have frequent assaults and will have to use the grenade both in offensive and defensive combats.

For all assaults the grenade is an indispensable asset. After artillery preparation the enemy must be routed to permit the skirmishers to gain their objective, which is the trench occupied by the enemy. The enemy must be pursued from these dugouts and driven back from barricade to barricade. The resistance of a few adversary bombers must be overcome as they are well supplied and completely sheltered, which makes their post unapproachable. It is necessarry to immediately stop grenade counter attacks which advance in small groups, and are very often successful in chasing an assaillant greater in number but unskillful in handling grenade. It is finally necessary

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that daring groups, profiting by the disorder of the enemy, pursue after the attack, take the strong points and organize a solid resistance.

To this group of hand bombers and rifle grenadiers belong courageous and honorable duties.

* * *

The efficiency of units using new mortars will only be realized on the three following conditions:

1. The new mortars must act in **connection** with one another.
2. Their **supply** must be constantly assured.
3. Men in charge of these weapons **must be well instructed.**

Machine guns and the cannon de 37, as well as the automatic rifles and rifle grenades combined make it possible and a valuable asset for the infantry in forcing the enemy to shelter under their fortifications, while the grenadiers and the light infantry advance to fight a hand to hand struggle.

Firing arms with **flat trajectory**, such as machine guns, automatic rifles, cannon de 37, are used more especially for open open warfare. Firing arms with **curved trajectory** like grenades and trench mortars attack all that is entrenched.

Riflemen complete and improve results obtained by specialists.

Replenishments must therefore be particularly organized so that the mortars can at any moment have the necessary ammunition. This replenishment is all the more difficult to obtain, as ammunition for the new mortars are heavy and cumbersome.

Coaching is now more necessary with the new armaments than is was with the old.

These firearms which cause such destruction are to be handled by educated, disciplined and courageous soldiers only, and in charge of officers having special knowledge in their use.

In modern warfare fighting methods are incessantly being modified; then it is the duty each and every one to follow the evolution and to take advantage of the accomplished progress.

"T'IS THE SURVIVAL OF THE FITTEST."

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PART ONE

HAND GRENADES

According to range, grenades may be divided into three classes:

1. **Hand Grenades**, with a maximum range of about 50 yards. Among these we find explosive grenades, poison gas grenades, tear-producing grenades, suffocating grenades, incendiary and smoke-producing grenades.

2. **Rifle Grenades**, with a range of 50 to 450 yards, belong to the classes indicated above.

3. **Trench-mortar Grenades**, with ranges from 200 to 1500 yards depending upon the gun, belong to the classes indicated above.

CHAPTER I.

FRENCH AND AMERICAN GRENADES.

1. MISCELLANEOUS.

A hand grenade must be thrown as far as possible and also have the power to destroy, and retain in a general way the following qualities:

1. Not weighing more then 21 or 31 ounces.

2. Shaped so that it will not encumber the carriers and travel easily through the air.

3. Produce the greatest efficiency, either by the nature of its body, or by the effect of the explosives used.

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4. Shall have an ignition process as light as possible, and also as voluminous as possible, so it will not increase the weight and minimize the capacity of loading the grenade.

5. The process of ignition shall also be provided with a safety device which will permit under all circumstances its transportation without danger.

6. It is also important that its ingredients mix well with the explosives that will cause flame and smoke.

But bear in mind the necessities of battle. The small range of the hand projectile, forces the grenadier to keep protected from splinters from the exploding grenade, these considerations will limit without completely destroying the offensive properties of a grenade loaded with an explosive enclosed in a metalic cover, be powerful in its destruction qualities and by the demoralizing effect it can produce.

A bomb of this kind cannot be used in an open field or in assaulting a trench, the fragments of which are very dangerous and scatter into a wide range.

It is very important that the assailant have a gun that will permit him to clean up a trench the moment he has occupied it, for he is almost sure to meet an enemy bayonet awaiting him.

For the offensive in an open field the need of a grenade that will project no fragments for more than 10 yards from the point of its explosion; that will insure safety to grenadiers in an enemy entrenchment.

These grenades must be destructive and demorilizing.

II. CONSTRUCTION.

A grenade, a bomb or a torpedo consists of three elements as follows:

1. A grenade body producing fragments that will destroy.

2. A grenade with a thin covering that will not give off destructive fragments for the thrower.

1. **A grenade body,** (Fig. 1), or an **explosive body,** (Fig. 2).

The grenade body has thick walls of steel or cast iron which when the grenade explodes breaks up into fragments.

The explosive box consists of two parallel walls. Between the parallel walls there are steel or lead bullets.

2. An **explosive:** Black powder or chlorated explosive or perchlorated explosive. These are chemical mixtures in which

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the oxidizing agent is chlorate of potash or soda or perchlorate of potash or ammonia. The combustible can be varied. In

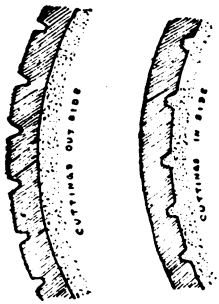

Fig. 1

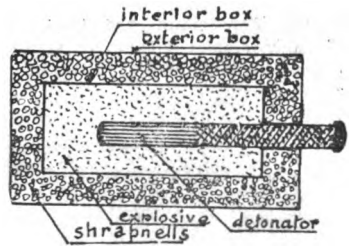

Fig. 2

the "cheddites" the combustible is castor oil, vaseline or paraffine.

3. **A firing mechanism** comprising:

(a) A detonator loaded with fulminate of mercury and a small quantity of melinite. (Fig. 3).

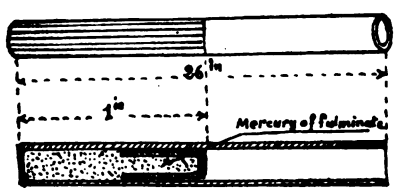

Fig. 3.

(b) A time fuse causing delayed explosion to the detonator.

(c) A process of ignition of the fuse (Generally a **primer** and a striker actuated by direct shock or by tension of a percussion spring. (Fig. 4).

III. CLASSIFICATION AND MECHANISM OF GRENADES.

As regards their ignition they are classified into two types:

(a) Percussion grenades.

(b) Time fuse grenades.

As regards their tactical employment they are classified into two types:

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(a) Defensive grenades.
(b) Offensive grenades.

(A) As Regards Their Ignition.

(a) **Percussion grenades** explode by shock at the end of their course either by shock of a movable striker against a fixed primer or by shock of movable primer against a fixed striker.

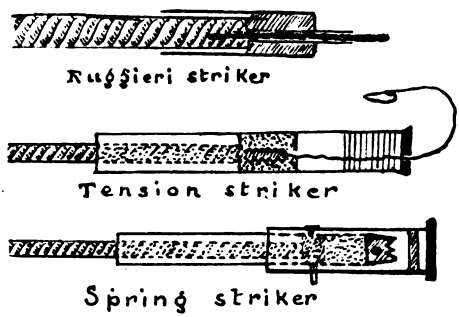

Fig. 4.

(b) **Time-fuse grenades** are supplied with a system of delayed ignition, that is to say that they explode a few seconds after the lighter has acted (on an average of 5 seconds)

Experiments on the Argonne front (grenadiers school of St. Florent) as regards their frogmentation after explosion, the F and "Mills" grenades gave the following results:

1. **Throwing an object in an open field.**—A grenade of each kind was thrown in a square room 11 feet on one side by 9 feet high, of pine boards 1 foot 8 inches in thickness and papered. It was contended that each grenade gave an average of 250 points of impact on the walls, 28 fragments perforating the boards.

---

(1) In order to avoid confusion in joint attacks an agreement has been entered into by the French and British Armies that none but time-fuse grenades will be used in either service.

Percussion grenades are largely used in the Italian service.

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2. **Throwing on an object placed in a trench.**—A grenade was thrown in a trench 13 feet in length, 4 feet in width and 6 feet in depth. (Fig. 5). Silhouette figures representing men in the standing position were the objectives.

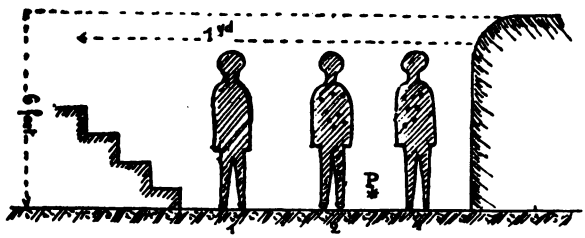

Fig. 5.

The grenade fell at the point "P" exploding upon coming in contact with the earth, lodging 13 fragments in silhouette, 17 of which were found at the height of the knee and 9 in the body. Silhouette 3 had seven fragments.

3. **Throwing on an Objective Protected by Breastwork.**

A grenade was thrown back of a breastwork where silhouette figures representing men in a prone position was the objective. (Fig. 6).

The grenade exploded at the point "P" causing a crater shaped hole 11 inches in diameter by 5 inches deep.

Silhouette 1 had 10 fragments, one of which pierced the pine boards 1⅛ inches in thickness. Silhouette 2 had 32 fragments, two of which pierced the pine boards. Silhouette 3 had a few scratches.

No point of impact on silhouette figure 4.

But the branch of a tree 22 feet distance from the shell-crater, produced by the explosion, received 5 fragments at 6 feet and 8 feet above the ground.

(B) As Regards Their Tactical Use.

(a) **Defensive grenades** explode giving shells or splinters in plenty, and are mortal. It is necessary that they be thrown from a well protected position against splinters which rebound.

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(b) The offensive grenades which are also known as assault petards.

They do not throw any splinters except the primer-plug on an average of 20 yards.

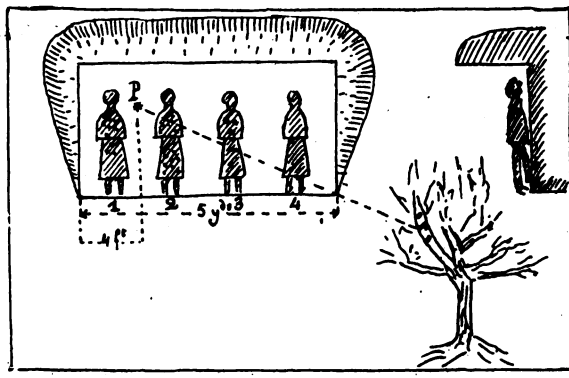

Fig. 6

They act principally by the force of the explosion. The force of this explosion is not mortally dangerous in an open field but is is a good demoralizer for the enemy by its powerful noise.

But when they explode in a trench their results are powerful. Experiments made at the grenadier's school of St. Florent demonstrated that each offensive grenade is able to mopp up a trench 15 feet long. Results from this explosion resemble those obtained by an explosive detonating in a closed vase.

Experience.—An offensive grenade thrown in a trench 6 feet deep where five silhouette figures, made from new lumber, 1'-18'' in thickness and spaced 3 feet representing men in standing position. The explosion of the offensive grenade threw 2 of the silhouette figures outside the trench and 2 of the silhouette figures were broken to bits.

The use of this offensive grenade during the most recent attacks proved the importance that they must be increased more and more.

To this classification belongs the grenades improvised with bottles or boxes of preserves filled with cheddite, the models which have been introduced by the allied armies under absolute necessity in 1914.

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N. B.—The British now use only the defensive type of grenade, while the French have both the offensive and defensive types.

IV. MANIPULATION AND TRANSPORTATION OF GRENADES.

The manipulation of grenades requires many precautions. A grenade is always dangerous. The danger is the direct result caused by the ignorance of those who do not know its fabrications or its mounting.

The transportation of live grenades from the rear to the war zone is made in boxes. The grenades are not supplied with primer-plugs. These primer-plugs are put into special boxes.

Supplies for bombers engaged in combat are sent in special cases of individual compartments and not in bulk to avert danger of explosion.

V. THE PRIMING AND IGNITION OF GRENADES.

A **Fused grenade** is a grenade which has its primer-plug.

An **ignited grenade** is a grenade whose system of ignition has been actuated by the bomber at the time it is thrown.

VI. CONSERVATION AND VERIFICATION OF GRENADES.

Grenades should be kept in cases and in dry places. Avoid subterranean dumps for grenades. The cases should be elevated from the ground to insure ventilation; the roof must be absolutely rainproof.

Detonator and primer-plugs must be kept separate from loaded grenades.

Use old grenades first. Frequently renew the supplies of grenades in the trenches. Stocks older than 6 months are dangerous.

Safety plugs must not be removed until ready to be thrown.

Avoid exposing these explosives to the sunlight or in a temperature exceeding 103 or 113 degrees Fahrenheit. The paraffine which composes in part these explosives, melts at 125 degrees Fahrenheit. If the explosives are kept in the above temperature they become sticky and thus lighting becomes difficult. Likewise if they are too damp it makes ignition impossible.

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The State of conservation of a perchlorate explosive is verified by constant attention, the components of these explosives are in their normal state, white. But parafine, vaseline, castor oil which constitutes the covering of these active compositions, is colored, so that when molecules of chlorate or perchlorate are poorly mixed white spots become visible. As these parts of the chlorate or perchlorate are more sensitive than the others by reason of shaking and rubbing, the explosive showing spots is then questionable and must be destroyed.

VII. HOW TO SELECT HAND BOMBERS.

All privates must be trained as bombers, but the men who are not cool-headed, the blunderers and the weak men should be considered as unable because they would be dangerous to their comrades.

Bombers must be carefully selected; it is necessary for a good bomber to be strong, energetic and animated with great courage.

To develop the physical condition of the men, the day's work should begin with calisthenic exercises and short talks on personal hygiene. This should be followed by exercises in throwing, climbing out of and running along the trenches, bayonet fighting and other movements relating to grenade fighting.

Bayonet Fighting.—Special instruction in the use of the bayonet is essential for bombers. The usual bayonet instruction given to all privates will accustom them to the use and balance of the weapon and teach the necessary movements. This, however, is not sufficient for the training of a bomber, but must be supplemented by practice in narrow trenches against living opponents. In trench warfare bombers will fight in inclosed and narrow spaces, where shock tactics are impossible. Methods in bayonet fighting similar to those of a swordsman are required, with a perfect combination of eyes, hands and feet. Practice is designed to develop ability and speed at close quarters. Contests should be arranged between men of the bombing squad, and the most proficient men should be selected as bayonet men.

VIII. HOW TO TRAIN BOMBERS AND SELECT BOMBERS.

Privates must be trained to throw grenades while standing, kneeling or in a prone position; the last position is very important in combat from shell-crater to shell-crater and requires particularly skilful physical training..

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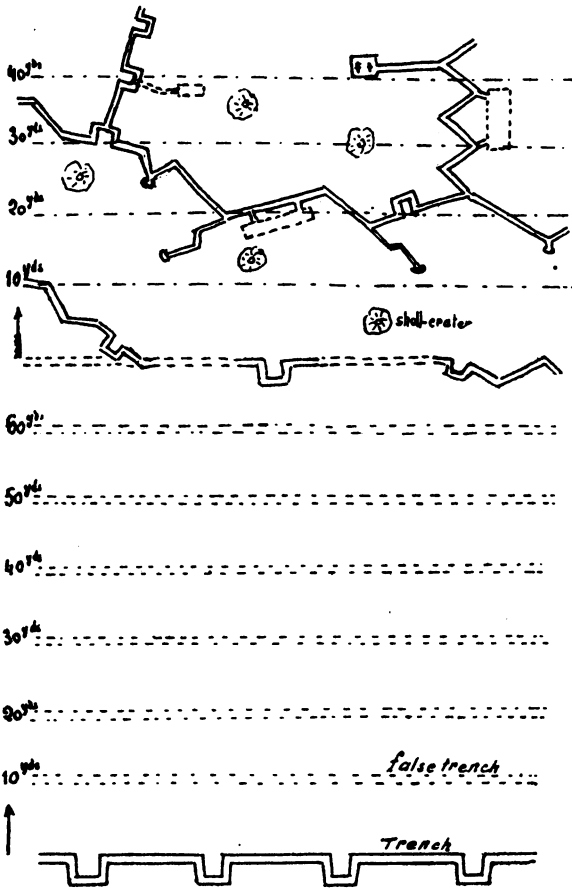

Fig. 7. Training Field for Bombers.

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The training comprises three different phases:

FIRST PHASE—Physical Training and Exercise in Throwing Dummy Grenades.

Requirements:

1. Accuracy.
2. Range.

Accuracy must be first considered. Accuracy permits one to obtain maximum results with minimum consumation of grenades. It is of major importance owing to the difficulty of obtaining supplies during combat.

An increase of range comes naturally by daily training.

The different plans of these physical training are as follows:

(A) Throwing in an open field. (Fig. 7).

(a) On dummy trenches 3 feet wide placed in echelon at distances of 10 to 70 yards.

(b) An objective which may vary from 1 to 3 yards apart enclosed in these dummy trenches by flags.

(c) On trench elements, listening posts, dug-out entrances,

(B) Throwing from a trench or approach trench into dummy trenches.

(C) Throwing from a trench or approach trench into another trench or another approach trench over an open field, over traverses, or over the corner of an approach trench.

(D) Throwing from a shell-crater into a trench or into another shell-crater.

(E) Results to be obtained:

1. Throwing from a distance; at least 30 yards.

2. Throwing with accuracy and speed; 6 grenades per minute on a square target two yards on one side placed horizontally at thirty yards from starting point.

SECOND PHASE.—Training of bombers for Throwing Live Grenades.

This throwing must be preceded by training with dummy grenades such as tin cans filled with sand and adjusted with "stoppers" and "primer-plugs."

The following precautions must be taken in throwing live grenades:

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(A) See that the fuses are properly adjusted to the grenades.

Special care also that:

(a) The detonator is well fixed.

(b) The mouth of the air-hole is open.

(c) The lock spring is not rusty.

(d) The notch of the releasing lever is well clasped to the lug.

(e) The fuse is really there.

(f) The safety pin is in readiness and the extremities sufficiently open.

(B) See that the primer-plugs are solidly adjusted to the grenades.

Prepare the detonators space in the explosive by boring a hole with a small piece of wood.

(C) See that the bomber is alone when throwing the grenade. Even the instructor must move away and leave the bomber to himself. The instructor must not permit the men to throw the grenades all at the same time unless there is protection by traverses.

(D) Do not pick up and throw a grenade which has failed to explode. Destroy it at once according to indications noted on appendix I.

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(E) See that the primer-plug is never hammered more than once on one grenade. After a live grenade is hammered it should be thrown immediately.

(F) The throwing of live grenades must be done under the supervision of company officers. But bombing officers should be present during the throwing to oversee and correct errors.

THIRD PHASE.—Tactical Instruction for the Squad or Group of Bombers.

All infantry men should receive sufficient instruction to enable them to pass readily and quickly to the status of grenade combat, and special instruction given to grenade squads should enable it to carry out any of the special technical operations for which grenade fighting is suitable.

After the men have received a thorough training in individual instruction prescribed above, the necessary teamwork will be secured by squad training.

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*See appendix III for work concerning the execution of a contest for throwing grenades.

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Instruction of "Select Bombers."—In addition to the instruction given to all men of the bombing squad expert bombers receive a special course and follow a more thorough training. This special course comprises:

1. The making up of explosive charges.
2. The making of dummy grenades.
3. Utilization of foreign grenades and detonators.
4. The use of trench mortars of low power.

The special objects of the course for expert bombers is to make expert throwers with confidence in their skill; to provide men capable of organizing a grenade combat and carrying it to a successful outcome; and to provide leaders among the men to serve as examples to be imitated by their comrades.

IX. METHODS OF THROWING.

The bombers may occupy, during battle, various positions. They may throw grenades into the approach trench longitudinally or either at right angles or obliquely from it. In order to meet these different conditions special methods of grenade throwing have been adopted. These methods have been derived from the British method and have been approved in the French regulations in "Combat a la grenade" of April 7, 1916.

The method of throwing is the basis of instruction of the Bomber. It is of vital importance that the instructor pays constant and rigorous attention to the principles of this method. Careful observation to instruction concerning methods of priming and throwing, particularly to each type, should be given.

Execute the operation of throwing rapidly but without precipitation (on an average of 2 seconds in the cadence of quick time).

(A) Throwing Along the Approach Trench Lengthwise.

(a) **FIRST METHOD. Throwing the grenade at the same time balancing the body without taking a run.**

Initial Position (Fig. 8).—Aim at the objective with the extended left arm with the grenade in the right hand and the right arm falling naturally by the side. The shoulder, the extended left arm, and the objective should be in the same vertical plane.*

First Motion. (Fig. 9).—Left arm forward held in the direction of the objective. Carry the grenade near the left hand.

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Second Motion. (Fig. 10).—Raise left arm and extend in the direction of the objective. Describe a semi-circle with the right arm until in a vertical plane. Balance the body laterally bending the right leg and stretching the left leg forward elevating it from the ground. Follow the grenade with the eye so as not to strike side of the trench. Stretch the left leg,

Fig. 8

Fig. 9

Fig. 10

raise left heel or foot from the ground. All the weight of the body should rest on the right leg.

Third Motion. (Fig. 11).—Cast the eyes at the objective or at the aiming point, if throwing from a trench.

Fourth Motion. (Fig. 12)—With the right arm describe the arc of circle in a vertical plane, the right shoulder and the body following the movement of the arm, extending the right leg and bending the left knee. The left arm is swept vigorously downward and backward, following the left shoulder, which is sharply "refused."

Finish with the entire weight of the body in the throw. Release the grenade while executing a twist of the trunk to

---

*During instruction, place the private facing the objective. At the command:

"To throw a grenade."

"Get ready."

Execute right face, carry the right foot to the right of the left foot and raise the left arm in the direction of the objective, palm downward.

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the left, right shoulder on a line with left shoulder. Turn on the right toe at the time of twisting the trunk.

N. B.—The grenade thrown under these conditions should fly in the direction in which the left arm was pointed, and the maximum range should be obtained. The right arm acts like a catapult.

Fig. 11.

The time of the throwing is about two seconds, (two motions per second).

(b) **SECOND METHOD.—Throwing the grenade at the same time balancing the body and taking a run.**—The Principle of throwing is similar to the preceding one with this one addition. At the beginning of fourth motion the thrower hops on his right foot. The range is thus increased **from 3 to 5 yards.**

Fig. 12.

B. **Throwing Across an Approach Trench. (Fig. 13 to 18).**

(a) **FIRST METHOD.—Throwing** with out-stretched arm.

Initial Position.—Facing **the wall** of a trench execute a right half face carry the right **foot to** the right of the left foot.

Fig. 13

Fig. 14

First Motion.—Incline the trunk downward and to the left and while in this position ignite the grenade.

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Second Motion. (Fig. 13).—Carry the right arm in an outstretched position to the rear. Follow the grenade with the eye.

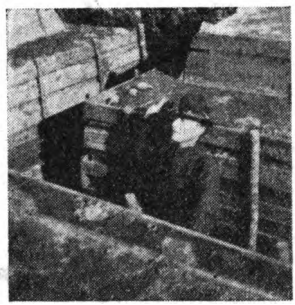

Fig. 15

Fig. 16

Third Motion.—Aim again at objective.

Fourth Motion. (Fig. 14).—With the right arm describe the arc of a circle in a vertical plane; release the grenade

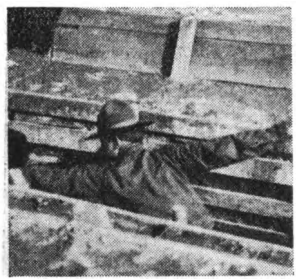

Fig. 17

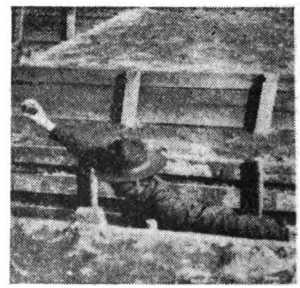

Fig. 18

while executing a twist of the trunk to the left. Turn on the right to and allow the left arm to follow the movement of the body.

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(b) **SECOND METHOD—Throwing with bent arm (putting the shot).**

Initial Position.—As above

First Motion.—As above.

Second Motion. (Fig. 15).—Raise the right hand just above the shoulder and to the rear of the body, bending the arm. Carrying at the same time the shoulders to the rear according to the strength desired in throwing. Follow the grenade with the eye.

Third Motion.—Aim again at objective.

Fourth Motion. (Fig. 16).—Straighten the right arm in a vertical plane and carry the body forward, then release the grenade. The left arm to follow the movement of the body.

(c) **THIRD METHOD—Disc Throwing Method.**

Initial position.—Facing the wall of a trench execute a right face, carry the right foot to the rear of the left foot.

First Motion.—Incline the trunk downward and to the left and while in this position ignite the grenade, without moving the right foot.

Second Motion. (Fig. 17).—Turn from the hips and rotate the trunk from left to right, the right arm extended downward and in rear of the body. Follow the grenade with the eye.

Third Motion.—Aim again at objective.

Fourth Motion. (Fig. 18).—Throw the grenade, raising the right arm forward and upward near the body, the left arm swinging backward. Release the grenade when the right arm has reached the extent of its course. Increase the force of throwing by an effort of the right shoulder.

(c) Throwing in a Kneeling Position.

Initial Position.—Facing the objective carry the right foot to the right of the left foot. Place the right knee on the spot occupied by the right foot. The left foot remains stationery.

First Motion (Fig. 19).—Incline the trunk downward and to the left and while in this position ignite the grenade.

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Second Motion (Fig. 20).—Rock the body from left to right. With the right arm describe the arc of circle and carry the right arm backward and downward. Follow the grenade with the eye.

Fig. 19

Third Motion.—Aim again at objective.

Fourth Motion. (Fig. 21).—Release the grenade, while executing a twist of the trunk from right to left, straightening the right leg.

(B) Throwing in a Prone Position.

Initial Position.—(Fig. 22).—Lying flat on the stomach slightly raise the body above the ground, resting on the forearms and on the tips of the toes.

Fig. 20

Fig. 21

First Motion.—Bend the left leg, bringing left knee under the stomach and rest weight of the body on the left leg. In this position ignite the grenade.

Second Motion. (Fig. 23).—Execute a rotating of the body from right to left, using the left hand as a lever. Bend the right leg, lifting the left knee in accordance with the force desired in throwing. Follow the grenade with the eye.

Third Motion.—Aim again at objective.

Fourth Motion. (Fig 24).—Release the grenade while ex-

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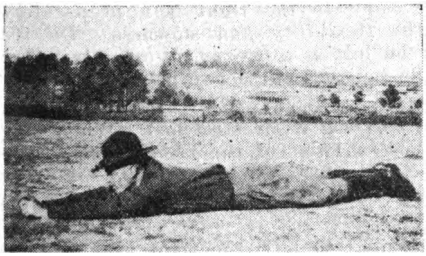

Fig. 22

Fig. 23.

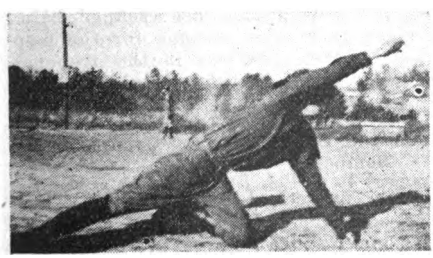

Fig. 24.

ecuting a twist of the body from right to left, straightening the leg.

N. B.—To obtain greater accuracy and greater range, it would be advantageous for the bomber in the "prone position" to retake the "kneeling position." As soon as the grenade has been thrown he returns to the "prone position."

GENERAL REMARKS.

1. The complete movements of throwing is not practicable if divided and executed by the number, like the manual of arms, unless for purposes of instruction. This movement requires much flexibility and is obtained by swinging the body form right to left and vice versa several times before effectiveness can bo obtained in throwing.

2. The entire body, and not only the hand arm that holds the grenade, must be put into action. A powerful swing depends on

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both the legs and trunk.

3. The swing of the body to the right is a preparatory movement relative to the flexibility and slowness. On the contrary, the swing to the left is a movement of relaxation. No pause should be made between these two movements.

4. After bending toward the right, the trunk must be on a straight line with the left leg while stretched. When long distance throwing is made a twist of the body from left to right takes place at the end of the swing, the arms moving with the shoulders, bring the right arm to the rear of the thighs.

5. In the swing from right to left the right arm remains extended and is raised to a vertical plane. This recommendation is essential. The thrower must avoid to swing his arm in a horizontal plane, (it is a mowing movement).

6. Practice daily exercises in throwing with the left arm.

IX.—TACTICAL EMPLOYMENT.

A. Generally.

Grenades are as important to the infantryman's armament as the rifle and bayonet. All infantrymen should be able to intelligently engage in grenade combat.

In the defensive hand grenades are excellent weapons for close range fighting.

It makes possible by the aid of well trained bombers, the destruction of strong points and protection of defenses, salients, machine guns, command posts and entrances to approach trenches.

In the offensive the hand grenade makes it possible to harrass the enemy under cover who has just escaped being bombarded. It is likewise an invaluable weapon for the mopping up of trenches, step by step progress in the trenches, and overthrow terrain. Lastly it is a very valuable weapon for use in raids.

(B) The Organization and Equipment of "Groups of Bombers.

In each Battalion: a first or second lieutenant, especially chosen to have charge of battalion platoon (to be a selected platoon of bombers) and supervise training of bombers in the companies.

The squads of this platoon are usually attached to their company and are only called upon in time of combat.

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In Each Company: 1. A well trained officer familiar with use of the grenade and who will constantly supervise the training of the men and to see that there is always a replenishment on hand, be careful about the conservation of grenades.

2. One section of "hand bombers" (first section of each platoon) comprising 3 teams, each having 1 leader (corporal or private, first class), 1 thrower, 1 carrier, 1 scout, either: 3 leaders (2 corporals and 1 private, first class), 3 throwers, 3 carriers and 3 scouts by section.

Total: 6 leaders, 6 throwers, 6 carriers 6 scouts by platoon and 24 leaders (16 corporals and 8 privates, first class, 24 throwers, 24 carriers and 24 scouts by company.

(a) Groups of Bombers Designated for Combat.

The "groups for combat" are generally as follows:

1 corporal or non com group leader.

2 throwers.

2 carriers.

2 scouts or riflemen or bayonet men or assistant.

1 connecting file or spare bomber.

Each bomber being capable of immediately filling any one of these roles upon being designated as thrower, carrier, or assistant.

The squad of 1 corporal and 7 bombers will then consist, under its squad leader, for example, of 2 throwers, 2 carriers, 2 assistants and 1 spare bomber. Or it may sometimes fight in two reliefs of 3 bombers each one commanded by the corporal and the other by the most energetic bomber.

More important groups will often be formed under the orders of a sergeant or a bomber officer to carry a more extended point of resistance. Sometimes all the bombers of a company or a battalion will be grouped together.

The combat of such a group is the combination of the partial combats conducted by the groups of four or eight bombers between which the bomber officer has divided the whole objective, each being assigned to some carefully chosen point.

The instruction of the small squad is then the tactical basis of grenade combat.

The Group Must be Trained to Fight.

(a) Acting alone, step by step, progress in a trench or approach trench.

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(b) In connection with other groups of grenadiers for raids.

(c) In connection with the Auto-rifle and Rifle-grenade in open field bombardments.

(d) In connection with their section for a general attack.

(e) In connection with the riflemen for "mopping up" the trenches.

In any of these cases each one of the group must know perfectly well not only what is his mission, the duty which he must personally perform, but know final results and objectives desired.

(b) Duty for men of this group of bombers.

1. Duty of the group leader:

The squad leader directs the combat, he distributes the men according to their qualifications, place them in the trenches or communicating trenches so that they will not be crowded, organizes the reliefs of throwers and carriers, he looks after the replenishment of grenades.

The squad leader seizes promptly every occasion to advance; if the advance becomes impossible, he prepares to defend the ground foot by foot, multiplying the barriers.

The bombers officer being in command of a much larger group, has two principal tasks:

2. Duty of the scouts.

The "Scouts" should be chosen from among the most decided and alert men; they should be good shots and skillful in the use of the bayonet.

Their duty consists in looking after the security of the "throwers." They are sometimes called "assistants."

In a frontal attack over open group they support the "throwers" and protect them with their fire.

In the approach trenches they precede the "throwers" and pass around the traverses or bends ready to stop any offensive return of the enemy. They endeavor to report the location of the fall of the grenades to aid in correcting the fire, and signal to their squad leader the instant that advance is possible.

When further advance is impossible they notify their chief. Without waiting for orders a barrier of sand bags is thrown up as soon as possible and the "assistant grenadiers" take position to open fire.

In street fighting they watch especially the doors and windows.

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Their equipment consists: 1 rifle; 56 cartridges. 1 Trench knife; 1 periscope; signal flag or a flare pistol and 2 signal cartridges; 8-16 grenades, F. I.; 8-16 grenades, O. F.

3. Duty of the Throwers.

The "throwers" should have their hands entirely free in order to manipulate the grenades without difficulty; they carry the rifle slung on the shoulder during combat.

For defense, they are provided in addition with a pistol and a trench knife.

The "throwers" will not always be able to carry the rifle when the fight is not to be followed up, as in the execution of a surprise attack.

Their equipment consists: Automatic pistol, 27 cartridges; Rifle, no cartridges; 10-20 grenades, O. F. or 20-40 grenades, O. F. The thrower must not carry rifle slung during raids.

4. Duty of the carriers.

The "carriers" look after the replenishment of grenades. They replace the "throwers" if the latter are put out of action. They are armed alike.

Their equipment consists: Rifle, no cartridges; Automatic pistol, 27 cartridges; 10-20 grenades, O.F.; 20-40 grenades, F. I.

(c) Formation on the march of groups.

These groups usually advance in the same manner as patrols and reconnaissance parties.

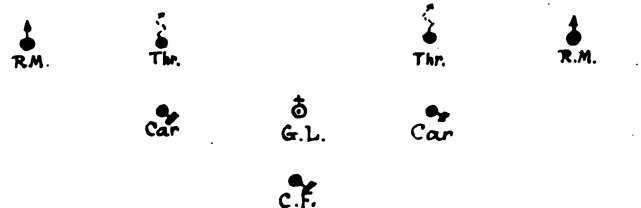

Fig. 25.

To reconnoiter the objective; to distribute the squads or groups.

To replenish the squads.

This second task demands the greatest energy, discernment, and initiative.

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The squad leader takes the place from which he can best control and direct his group.

The "scout bombers" are directed to reconnoiter the front and flank and to protect the other bombers in case the enemy is encountered.

In crossing open ground the groups advance as skirmishers. The assistants are distributed in the line and are grouped particularly on the wings to support the grenadiers; in case of meeting the enemy the assistants reconnoitering the march rejoin the line.

In marching in the approach trenches the groups form in single file in the following order: "scouts," "throwers," "carriers."

(B) Grenade Fighting.

Grenade fighting may have for its object:

1. The defense of a trench in close-range fighting. Extermination combat.

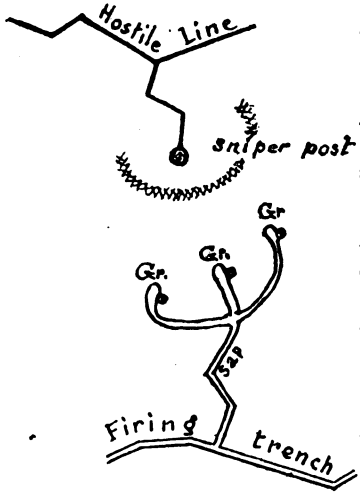

Fig. 26.

2. Step by step progress in a trench or approach trench.

3. Preparation for an assault of a hostile trench.

4. Close range fighting within a hostile position and "mopping up" the trenches and bomb proofs.

5. A trench raid.

6. Renewal of contact with the enemy after conquering designated objectives.

1. The defense of a trench in close-range trench fighting. Extermination combat.

In defending a trench, bombers posts and bombers platforms, grenade stores must be ready in advance:

(a) At the head of the first line trench in the listening posts, facing the enemy's listening posts (Fig. 26), in shell-holes connected with first line trenches connected by mining galleries (Fig. 27). The posts may be reinforced by auto-rifles and by machine guns.

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(b) Bombers are distributed in groups along the line; the

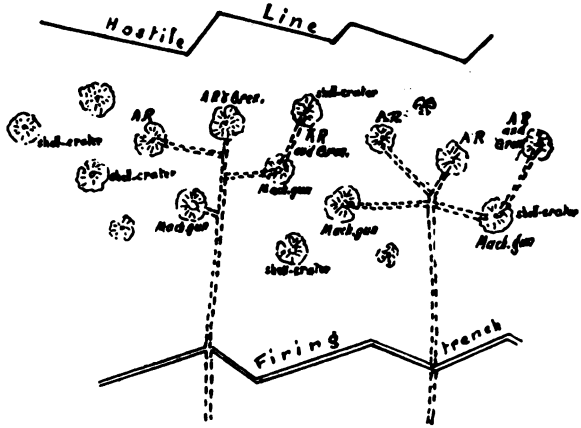

Fig. 27.

number is increased on exposed front (in salients and parts

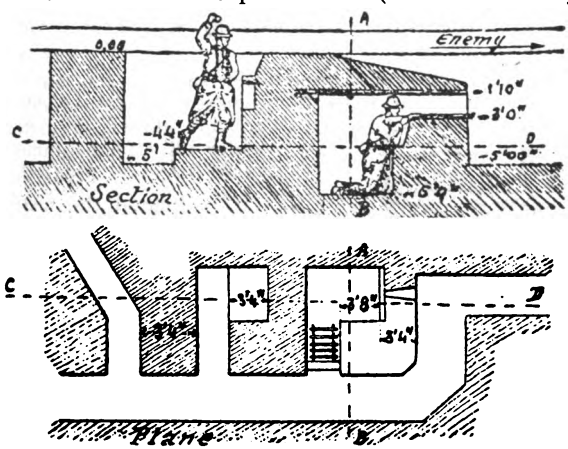

Fig. 28.

which are very near the enemy's trenches). It is better, in the

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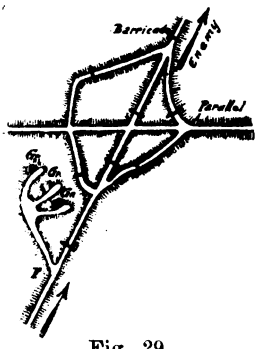

Fig. 29.

latter case to double these portions of the trench by other lines very close to the first, so as to form subsantially two ranks of bombers in these places.

All soldiers who have had any training in this work should be able to take part in forming a barrier with grenade fire at a distance of 30 yards; this can be done by one grenadier to 12 yards of front using O. F. grenades, and by one grenadier to 30 yards of front using F1 grenades. In order to avoid continual losses in places where the hostile trenches are very close to our own, a decided superiority should be seized in the throwing of grenades and the hostile trenches rendered untenable.

(c) In the cover trench.

(d) At the entrance of approach trenches, at the angles of long approach trenches and at all places where step by step possession is desired, especially in straight places, (Fig. 28), and around crossings, (Fig. 29). These trench crossings or approach trenches are surrounded by a platform for three bombers.

(e) In the dug-outs to permit the men to come out in case the trench was invaded by the enemy. Reinforced doors and grenade chutes in order that under all circumstances a defense may be assured.

Fig. 29a.

(f) Behind the barricades. The different squads should be trained to make counter attacks with grenades quickly, to retake any part of the trench which may have been taken by the enemy.

2. Step by step proress in a trench or approach trench.

No matter how the bombing groups are organized or wherever they are placed, in

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units of attack, fighting with grenade begins when enemy's first line trench has been reached.

Whether the fighting be in trenches or in approach trenches zig-zags or traverses will always be found.

Only the minimum of men actually needed for the work should be exposed to the enemy's grenades, and they should not be crowded as to prevent free movement. This form of fighting is very severe and frequent reliefs should be provided for; and the squad leader should be able to replace immediately an injured man and to reinforce, if necessary, the leading group by fresh scouts or throwers.

Progress takes place as follows: (Fig. 30).

(a) The two "scouts" who send out reconnoitering parties

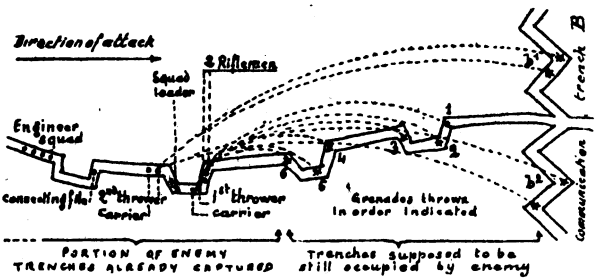

Fig. 30.

ahead, prevent the enemy from advancing and protect the bombers.

(b) The two "throwers" followed by their "carriers" throw grenades in a methodical manner on points 1, 2, 3 and 4, 5, 6. These grenades are always thrown into hidden passages and thus assure a constant and progressive mopping up.

(c) The "squad leader" in charge directs the throwing of the grenades, organizes the reliefs of throwers and carriers, oversees the supplies and is ready to defend the terrain step by step if progress is impossible.

(d) The "connecting file."

This first group is usually followed by: (Fig. 31).

(a) An auto-rifleman assisting in the work of the bombers, watching the heads and arms of hostile bombers.

(b) The six rifle grenadiers of the platoon. Their function is to outguess the range of hostile rifle grenadiers; to

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bombard an enemy approach trench as far away as possible; to prevent the arrival of supplies and reinforcements.

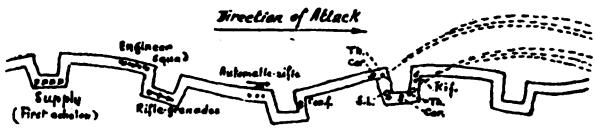
The second group is usually followed by:

(a) A group of "workers" and a "pioneer."

This group should be able to construct a barricade or destroy that of the enemy. Shovels, picks, empty sand-bags and explosives are supplied him. Pioneers are specially instructed to destroy the barricades.

(b) By chain of replenishments.

(c) By a series of echelons which are in proportion to the distance.



DISPOSITION OF THE COMPLETE GROUP (SCHEME)

Fig. 31.

Maneuver.—At the command "Report!" given by squad leader, the two scouts advance rapidly beyond a traverse or the corner of an approach trench so as to be sure that the intervals are open.

At the cry of "All's Clear!" the squad leader orders his men to advance avoiding a rush.

Detailed Recommendations.

1. A profound silence should be maintained, so that all sounds coming from the direction of the enemy, and which might serve as an indication as to what he is doing, can be heard; communications should therefore be, as far as possible, by gestures and signals.

Thus progress is made from corner to corner, and from traverse to traverse.

2. Avoid having groups of more than three men in straight stretch of an aproach trench.

3. Advance cautiously, being always on the look-out for traps and enemy "ruses." (Fig. 32).

Straight stretches of trenches are often exposed to enfilade fire by rifles or a machine gun placed in a traverse. (Fig. 33).

The enemy hides himself at the bottom of an approach trench,

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the entrance of which is masked. And if one goes forward too rapidly the enemy comes out and attacks you in the rear. (Fig. 34).

Fig. 32.

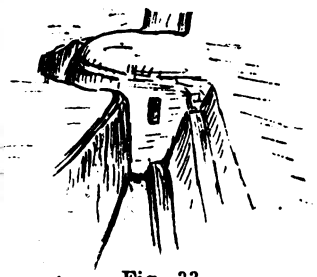

Fig. 33.

4. Verify the construction of the barrage. Sometimes the enemy pile sandbadgs on a platform made of planks or rifles, forming a bridge. The sandbags under the platform can be taken out without causing the other sandbags to slide. (Fig. 35). The enemy take out these sandbags while the watcher is looking over the top of the barricade.

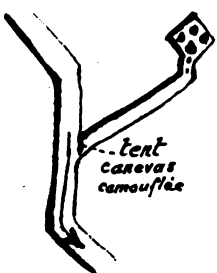

Fig. 34.

Fig. 35

5. Upon meeting a transversal trench, throw a few grenades on all sides (in b1 and b2) in series of three grenades. (Fig. 30).

Explore this transversal trench and build barricades and

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keep them guarded, if the order has not been given to continue through these transversal trenches. When the enemy has gained "fire superiority," the terrain must be held by step by step progress until "fire superiority" is regained. Then increase the barrage fire to hinder the advance of the enemy, and defend the barrage, either in the approach trench itself, (Fig. 35a), or near the aforesaid trench, (Fig. 42). All bombers must be able to rapidly construct an improvised barrage, back of which they will give all resistance possible. In the meanwhile the group of workers will construct a permanent bar-

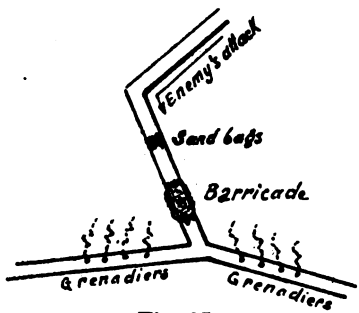

Fig. 35a.

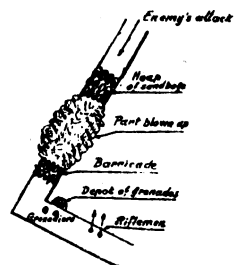

Fig. 35b.

rage, about 50 yards to the rear. Then the section of the trench, between the two barricades, should be filled, but it is, however, necessary to throw into the old approach trench, "chevaux de frises," "Brun spirals," "barbed wire," etc. The new parapets are torn down, (Fig. 35b). Thus the enemy works with difficulty, and cannot easily approach the "sap" and can only launch "counter attacks" in the open.

As soon as the barricade is finished, its protection is in the hands of auto-riflemen, reinforced by a few bombers and if need be, rifle-grenade men. (Fig. 36).

Means used to regain "fire superiority" consists in drawing the enemy into an ambuscade, and pit against him a larger number of throwers.

3. Preparation for an Assault on a Hostil Trench.

An assault is usually a combined action executed under cover of a powerful artillery fire. But sometimes a part of

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our line comes very close to the enemy and artillery preparation can not be made. An attempt is then made to overwhelm the enemy with grenades before rushing on him with the bayonet.

The throwers approach the enemy taking advantage of all cover afforded by the ground, the remainder of the squad awaits under cover the moment for making the rush. The

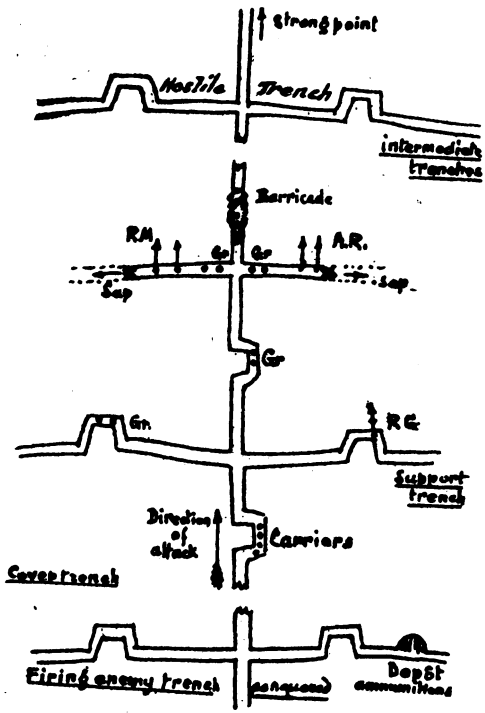

Fig. 36.

throwers overwhelm the enemy with a shower of well-directed grenades and compel him either to vacate the trench or to take cover in his bombproofs. (Fig. 37).

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In the meanwhile the remainder of the riflemen await the time for assault, at the same time being under shelter. Each of them holds himself in readiness to open fire on all hostile troops who might make an appearance, (especially auto-rifle-

Fig. 37.

men). This group executes several feint attacks or sham assaults to deceive the enemy and to compel him to show himself to the riflemen who are ready to open fire.

4. **Close Fighting in the Enemy's Position and "Mopping up."**

An assault is followed by a struggle within the hostile position. Preparations may be made in advance for this struggle by a reconnaissance of the enemy's defensive organization. Certain groups of bombers can then be assigned to definite tasks; for instance, mopping up the trenches and bombproofs, or gaining ground through the approach trenches toward the enemy's second or third line. The units which are assigned these tasks are required to rehearse them before making the attack.

Mopping up trenches requires two kinds of work which are quite distinct and which should not be assigned to the same units.

(a) The crushing of hostile units which continue the resistance at certain parts of the trench, and (b) the "mopping up" proper, that is to say, searching the trenches and bombproofs with a view to making sure that none of the enemy are left in them.

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The units which overcome the final resistance of the enemy are composed for the most part, if not exclusively, of bombers. They advance with the first or second wave. They are continually on the alert and seek out the points of resistance, skirting the trenches in order to aproach them on their weakest side. (Fig. 38).

Fig. 38.

The units charged only with mopping up the trenches have a definite task; they skirt the trenches and approaches rapidly and arrange their work in such a way that no part of the hostile position shall be neglected. (Fig. 39).

In order to lose no time, the moppers up do not go down into the trenches and approaches; they shower grenades along their route and they give special attention to bombproofs whose openings may have been covered up by the artillery bombardment so completely as to hide them. Prisoners are collected and taken to the rear under the charge of the officers or noncom's of the moppers up or by units specially detailed for this task.

N.B.—Fig. 39 shows the sketch of formation for attack of a French Battalion. It is possible to make an identical formation of American Battalion by studying Fig. 40, which shows the formation for attack of a platoon.

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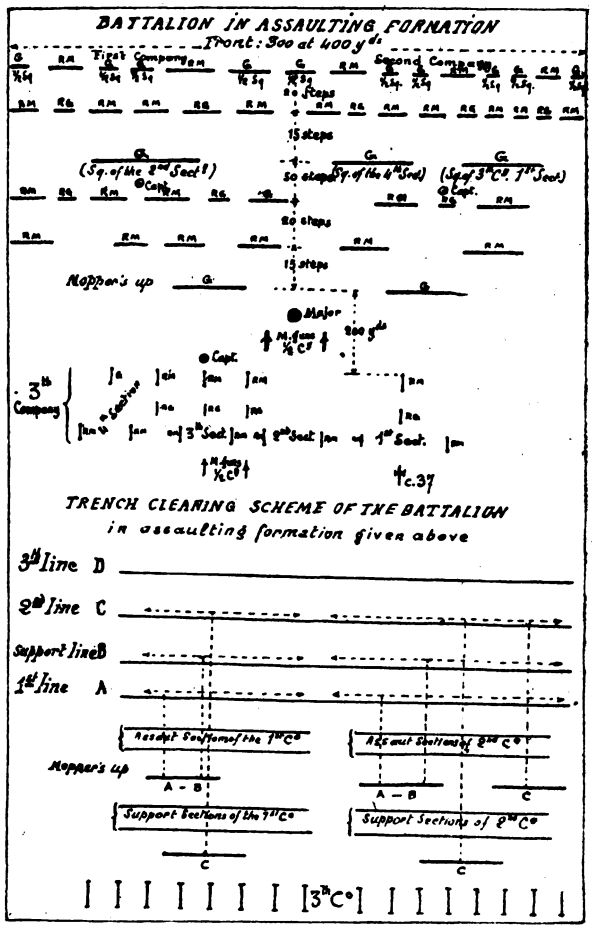

Fig. 39.

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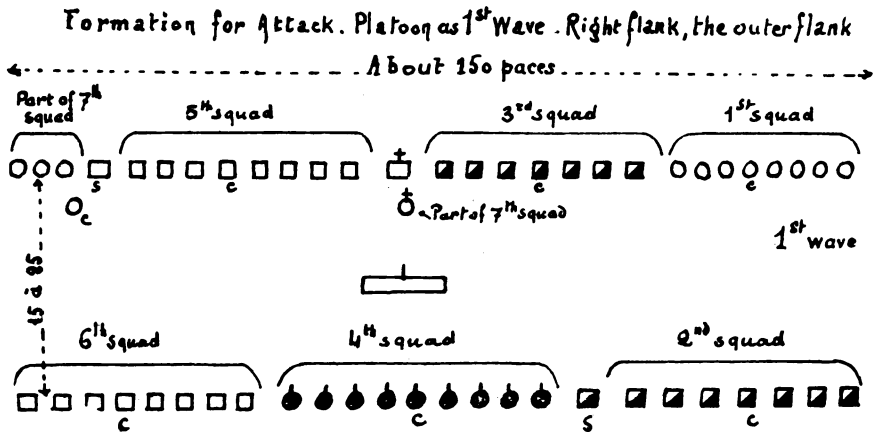

Fig. 40.—American Platoon in Attack Formation.

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(c) Mopping up of important objectives.—In particular cases for an attack or mopping up of a small town, of large farms and woods. it is advantageous to increase the number of bombers who form a part of the assault wave.

5. Trench Raids.

Grenades are freely used in trench raids. Trench raids are executed.

(a) By small groups of selected men, who have confidence in one another and are specially trained in handling grenades or

(b) By a selected unit, sometimes reinforced by additional officers or non com's, leaving the unreliable element behind.

The object of trench raids may be to:

1. Demoralize the enemy.
2. Destroy a part of his organization.
3. Make prisoners.
4. Obtain information.
5. Force the enemy to move his reserves under fire of our artillery.
6. Give to our troops the feeling of their superiority over the enemy.

Raids can be divided into two kinds:

1. Raids with artillery preparation.
2. Raids without artillery preparation.

The first kind requires a much larger force. The rules and orders for the attack of the company and battalion can be applied to such raids.

On the contrary, for raids without artillery preparation, it is necessary to study new points, the way of proceeding being completely different. Their strength is much less important and varies between a few men and one company. The most important factor for such raids is surprise. That is why it will generally be better to make them at night. A perfect knowledge of the ground is necessary. All non com's, corporals and privates must know exactly what he has to do. The hesitation of a single man may be fatal to the whole party. As regards the organization of the enemy, following points have to be thoroughly settled:

1. Route to be followed by the raiding party or distinct route for each group if the party is divided.

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2. State of enemy's obstacle, where all the intervals in his entanglements occur.

3. Where the sniper's posts are, machine guns emplacements, dug-outs.

4. Flanking positions of the enemy.

5. Approach trench junction or crossing.

All this information is obtained by any means at one's disposal, including aerial photos, which should be studied thoroughly.

The success of operations of this kind depends chiefly upon the preparations which have been made beforehand in the way of careful reconnaissances and by rehearsing in rear all phases of the operation under conditions as nearly like the real ones as possible.

Preparation for trench raids.—Especial care should be exercised in preparing for trench raids. The special preparations which an officer who is to conduct a trench raid should make are as follows:

(a) To make and have made all necessary reconnaissances (of the ground, of the obstacles, hostile trenches, etc.) The terrain should be studied with the object of selecting the routes of approach and of finding cover for grenade throwers within reach of the hostile position. The organization of the enemy's position may be studied from photographs taken by aviators.

(b) To select the best conditions for the operation(weather, hour, etc).

(c) To assign to each group or squad of grenadiers a definite task.

(d) To arrange the best possible system for keeping up the supply of ammunition and grenades.

(e) To acquaint the infantry and artillery units which are to support the operation thoroughly with his plans for executing it.

The officer who commands the trench raid should personally direct the units performing the main task. One of his subordinates should be specially detailed to supervise the replenishment of grenades.

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Effective material orders.—Effective.—Generally:

1. 4 men (scouts) to cut the wires if necessary.
2. The officer or N. C. O. and 6 men to attack the right flank of the enemy.
3. An officer or N. C. O. and 6 men with the same mission for the left flank.
4. One officer and 5 men with 3 telephone men and 2 stretcher bearers to attack the trench in front.
5. Reserve group of 2 N. C. O's. and 10 men to be ready to support any group in case it is repulsed.

Materials.—Most of the time it will be necessary to bring tools and explosives. A reserve supply of grenades may also be brought, in case the operation lasts some time. Sand bags will be necessary to build barricades. Illuminating rockets or flares may also be useful to reveal the enemy's counter attack.

Orders.—The order given by the raid leader to his N. C. O's., and men should be a written order which is to be studied and read by all several times, so that everyone can have no doubt about his task.

For instance, an order may have the following shape:

1. Mission to be fulfilled.
2. Exact time of the start.
3. Division of the task between groups.
   (a) Task for first group.
   (b) Task for second group.
4. March of approach.
5. Attack.
6. Work to be done in the position.
7. Retreat.
8. Dress and equipment.
9. Materials, tools, ammunition.
10. Signals.
11. What is to be done in case of failure.

Execution of Trench Raids.—The troops making the trench raid approach the hostile trench silently; if preparation has been made by artillery fire the approach should be rapid. When they reach the points selected for crossing the obstacles

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(which are supposed to have been destroyed) a volley of grenades is thrown into the hostile trench; as soon as they burst the bombers rush the trench.

Similar tasks are performed by two units, which, on reaching the hostile trench, proceed to mop it up, one going to the right and the other to the left. Every care should be taken to avoid being caught under a discharge of hostile grenades; a position a few yards in rear of the trench which has been attacked may have been prepared for this purpose by the enemy. Sometimes it is better to select a very dark night or very bad weather for the raid. An understanding should exist between the groups of bombers and the garrison of the trenches from which they start. A few rifle shots fired under conditions agreed on beforehand warn the raiders that an illuminating shell is to be fired. The raiders lie down and take advantage of the light by examining the ground in their front. As soon as the light dies out they make a rush and then halt if necessary for another illuminating shell. During the mopping up of the trench the throwers' assistants provide for security in accordance with instruction given them before the start.

6. Renewal of Contact with the Enemy after Conquering Designated Objectives.

Finally Battalion bombers may be ordered after having conquered their objectives to go beyond their objectives and renew contact with the enemy.

The success of the said objectives does not indicate the end of the offensive action of the battalion. It is important to maintain in contact with the enemy, to recognize his new position, to prepare and execute the forward movement intended either to gain a new basis of assault or to improve to the utmost the success obtained.

It is necessary to enlarge the terrain conquered by the assault, to take advantage of the enemy's material and moral confusion before he can recover and to take possession of the supporting points which would be taken the next day at a heavy cost in men.

Keeping in touch with the enemy, reconnoitering, improving the success already obtained, are three things which require energetic and daring men who are cool-headed and of offensive spirit.

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One group of bombers, 4 auto-rifle crews, 4 or 6 rifle grenadiers with their carriers under command of an officer, first or second lieutenant, these are the first elements toward an advance.

A characteristic name has been given in The French Army to this unit of progression, it is the ANTENNA*, an organ of contact, of reconnaissance, having mobility, suppleness and power of fire which are given to it by proper combination of its compound part.

Each first line company sends one or two "antennae" forward; the objectives are designated by the Battalion commander in his plan of battle. The first limit of this progress is artillery barrage. To go beyond this limit it is necessary to stop the barrage fire.

Disposition of the Antenna.—The ground has been overthrown, the trenches blocked, the approach trenches, only, remain as a trail, but numerous shell-craters favor infiltration. The covers and the nature of the ground are utilised, the antenna must advance unseen and avoid being caught, yet careful about becoming a target for the enemy's artillery.

In the lead the bombers, widely spaced form the front of the antenna.

Twenty yards behind them the platoon leader, followed at 10 yards by 4 or 6 Rifle grenadiers, who are his reserves, his artillery. The 4 auto-riflemen are echeloned on each flank by two crews of two auto-rifles each. The riflemen come next as support echelon if necessary.

Arranged in this manner the antenna has an offensive power, able to destroy resistance which would try to hinder its advance. It is able to establish on a 100 yard front an impassable barrage.

Progress of the Antenna.—The bombers jump from one shell-crater into another; they reconnoiter, report and attack to facilitate reconnoitering. The rifle grenadiers give barrage fire at a range of 80 to 150 yards to clean shell-holes and concealed points.

The auto-riflemen sweep by fire the flat ground and advance by long rushes from fire emplacement to fire emplacements. They regulate their advance according to that of the rifle

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*The French call this disposition "Antenne" which means "feelers attached to the heads of insects."

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grenadiers, auto-riflemen the immediate support of the bombers and the other the flank guard. The latter assures the liaison with the neighboring antennae in such a way that a counter attack of the enemy, through the intervals would come under cross fire of the 4 auto-riflemen, independently of the fire of the machine gun platoons, which protect its advance.*

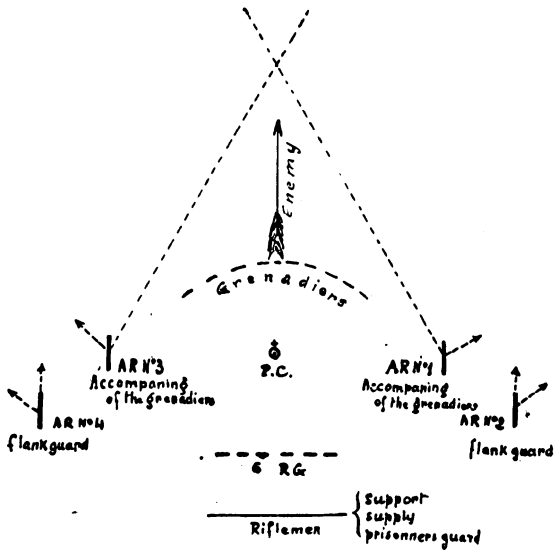

Fig. 41.

The incidents of the progress.—

1. **Nest of enemy's bombers.**—As soon as a bombers nest has been pointed out, it is reconnoited and attacked by bombers of the antenna. A first throwing with grenades O. F. produces a thick cloud of smoke which masks the enveloping attack as well as interfering with the rifle grenadiers.*

*The French call these fires on both flanks "encagement," which means "to put in a cage."

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The latter are placed on the same line to obtain a circular barrage. Their fire directed to fall in rear of these nests, route the enemy, hinder their retreat, also the arrival of reinforcements and replenishments.

The auto-riflemen assist the bombers by their fire and cover the flanks. "Encagement fire."

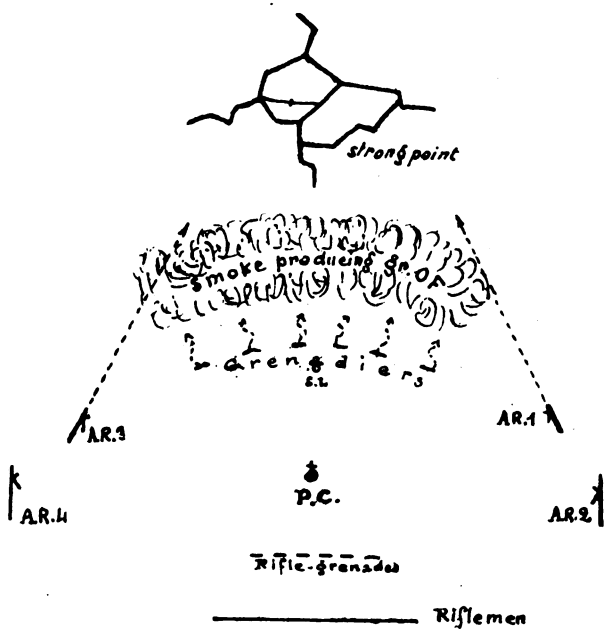

Fig. 42.

2. **Machine gun nests on an open field.**—The machine gun in an open field totally hinders the advance of bombers. It is then necessary to move.

First it is the auto-riflemen who return the enemy's fire. The noise of the auto-rifles, 1, 2, 3, cause the hostile machine gunners to lower their heads.

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Then the rifle grenadirs under the protection of the auto-rifle, go to their combat emplacements across the overthrown ground, where they will be able to start methodical and precise bombardments. They will be divided in two groups separated by a sufficient space to allow the concentration of fire on the hostile machine-guns.

Then the bombers can continue their advance as soon as the auto-rifle and the rifle-grenade have checked the hostile machine gun fire.

Organization of the ground. (Fig. 43).—The antenna reaches the objective designated by the major. It places itself in the shell-craters; the bombers in the salients, the auto-rifle in the reentrants so as to get flank fovements on the salients.

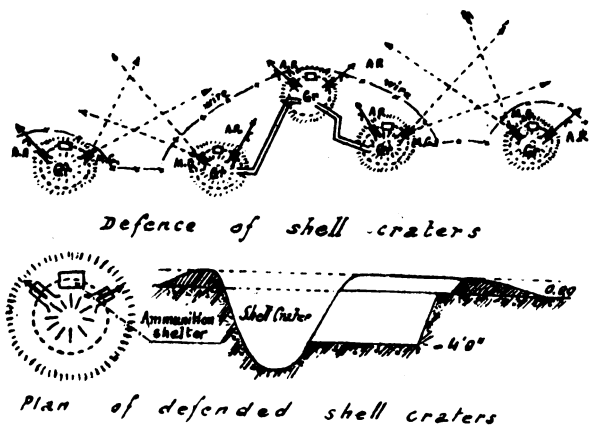

Fig. 43.

The antennae of the Battalion with that of the neighboring Battalions constitute a skeleton frame-work* for a new line which is organized as rapidly as possible against hostile offensive attacks. This advanced line is as soon as possible reinforced by machine guns.

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*The French call this "first frame," ossature, which means "osseous frame-work."

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Summary.—Such are the proceedings of reconnaissance and combat by the antenna, who, when apparently dispersed has a wonderful power of concentration.

Antennae under the command of energetic officers will give unexpected results; it is the complement of the assault; it is the tactical exploitation of success.

In the antenna, courageous, disciplined and trained men are needed, cool-headed commanders, animated with offensive spirit having plenty of initiative, having a thorough knowledge of the tactical employment of the new armaments of infantry.

XI. Replenishment of Grenades.

(1) **Replenishment during a bombing attack.**

The supply of grenades is perhaps the most important point in the organization of a grenade attack. Unless a constant and steady supply of grenades can be kept up, the attack will fail.

In case of a grenade attack from a line of trenches in which we are already established the principles on which this supply must be based are:

(a) Establishments of dumps for grenades, which must be kept filled, there should be one close to the spot from which the attack starts, one at battalion headquarters, and one near regiment headquarters to feed the latter.

(b) Preparation of each grenade by inserting the detonator ready for use before it leaves regiment headquarters, and by examining safety pins to see that they can easily be withdrawn.

(c) An initial supply carried by the man taking part in the attack. Every man should carry a supply of grenades.

(d) Certain and rapid transit of grenades from the dumps to their destination in order to maintain the initial supply. The most satisfactory method is to have a chain of men at intervals from the advanced dumps to the front of the attacking party, passing supplies up from one to another. Attempts to keep up the supply by sending men backward and forward along the trench for fresh supplies usually breaks down owing to the trench becoming blocked, or to the carrying parties being waylaid or lost.

The number of men required to form a chain at suitable intervals from the advanced dumps to the final objective requires careful calculation.

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The chain method may fail or prove costly in personnel if a hostile artillery barrage is formed.

Another method is to have a definite unit, e.g. a company, specially detailed to carry forward grenades. A unit so detailed should employ whatever method is best suited to the tactical situation, but must begin its work of bringing up supplies of grenades immediately the attacks are launched.

(c) A recognized chain of responsibility for supply officers commanding companies should be responsible for organizing the flow of bombs from advanced dumps to forward parties, the battalion bombing officer from the battalion depot to the advanced dumps, and the regiment bombing officer from the regiment to the battalion dumps. The regiment dump is replenished from divisional ammunition column.

(d) The sending of men from the front to the rear for the purpose of securing supplies is absolutely forbidden on the field of battle.

(2) **Useful Information.**

(a) One carrier is able to carry—

30 OF grenades, weighing (number limited by the bulk) (24 pounds),or,

30 F 1 grenades, weighing 40 pounds, or

40 suffocating grenades, weighing 35 pounds, or

25 AB grenades, weighing 40 pounds, or

40 VB grenades, weighing 42 pounds, or

50 to 100 empty sandbags, according to thickness.

Substitute for 1 full regulation haversack a load of 15 kilograms (33 pounds);; for 1 equipment with 88 cartridges and liter bottle, a load of 7.5 kilograms, (16 pounds).

It is always best not to fill the sandbags but to make them up in bundles of 5 to 8 kilograms (10 to 15 pounds).

These figures show that the platoon is fully replenished by four men and the company by four men making four trips; two carrying 20 OF, 10 FI, and 5 AB; the third, three sacks of 10 F1; the fourth, one sack of 10 F1, one sack of 5 AB.

(b) **Proportion.**—It is impossible to determine the proportion of OF. F1 and other grenades in an apportionment. It is too positive a statement to say that the F1 Grenades should constitute the major part of the depots, for combats have been

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waged with success with the OF only; it is the only grenade which can be used from concealed positions and certain bombers prefer it in all cases. A normal proportion is as follows: One-fifth smoke or incendiary grenades, three-fifths F1, and two-fifths OF; or the last figures might be reversed. The proportion of one-half incendiary grenades is proper for the moppers up (trench moppers).

(c) **Permanent Stores.**—In agitated sectors the following replenishment should always be on hand:

5000 to 6000 grenades at the Company. C. P.

8000 to 10000 grenades at the Battalion C. P.

12,000 to 15,000 grenades at the Regiment C. P.

In quiet sectors or out of the range of enemy grenades, the following:

1,000 to 1,500 grenades at the Company C. P.

5,000 to 6,000 grenades at the Battalion C. P.

8000 to 10 000 grenades at the Regiment C. P.

XII. Principles of Tactical Instruction.

A. For Bombing Officers.

Tactical instruction of the bombing officer is shown on "firing map" giving a reproduction of a German organization.*

(A) Defensive Position.—In an introductory lecture, the study deals with the utilization of bombers on a battalion front, having taken a defensive position. The following questions are treated:

1. Where should bombers be placed? How many? Strength of each unit? How many officers?

2. Use and disposition of strength of bombers remaining?

3. Disposition of grenades? Quantity? Stock always on hand?

4. Use of mortars, Rifle-grenades, Trench mortars. Objectives and emplacements?

5. What authority decides the disposition of bombers' posts?

6. How are supplies of grenades foreseen? Distribution? By whom? Under what conditions are they transported to the firing line?

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*(See "Firing Map" giving a reproduction of a German Organization, Appendix.

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7. When and where are the grenades adjusted with their detonators and ignitors?

8. What means are used and what precautions taken to keep grenades from being affected by humidity in the trenches?

9. Are bombing patrols sent out in the sector?

10. How are sap-heads protected? Most efficient means to use?

11. If the Germans posses "fire superiority" in the first line trench, how to organize a counter attack with the grenade? Would it be necessary to notify and call for machine gun assistance, and and if so, where and how?

12. How the constant supply of grenades may be assured in counter attacks.

(B) Offensive Position.—In another lecture the study of "bombers in attack," this work and enemy's salients will be made.

Everything must be carefully studied in advance.

Questions to be studied:

1. Study the map from a tactical point of view.

2. Necessary preparations for an attack. Depot emplacements. Distribution of personnel.

3. Number of bombing squads to be calculated in advance at such and such a point of attack.

4. Bombers attacking and going "over the top" with the infantry in attack. How the bombers will be placed in regard to the infantry? How they will cross over "No man's land?"

5. How will the bombing squads, with few losses, advance after the enemy's first line trenches have been taken. Where will it be convenient to send reserve men?

6. Point at which approach trenches taken from the enemy will be blocked?

7. A certain number of weapons is given to each attacking column: hand grenades and rifle grenades? How will they be used? Where? When? How?

8. Where will the machine guns, auto-riflemen, and rifle-grenadiers be sent for the blocade? Outside of the blocades? How? When?

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(C) Operations in Connection with the Infantry: Same questions to study and resolve:

1. The adjustment of bombers in regard to the infantry—Liaison.

2. Objectives not to be overlooked.

3. In a case when the first line enemy trench is taken without great loss, the first wave of infantrymen penetrating the second line. In a case of failure and retreat is necessary, etc.

4. Use of machine guns, auto-riflemen, and rifle-grenadiers for the blocade and outside of the blocade? How? When?

The bombing officer must see that the grenades and reserves at destination in time.

Grenade stores can be placed at the departure trench or even near the enemy's lines. They must be brought ahead as an advance is made. Then designated for extra duty must know the importance of their work. Officers or Non-com's may assist the officer in charge of operations, particularly to look after the supplies.

(b) **For Non-com's, squad leaders and privates.**

Make use of simple lectures, illustrated by diagrams, photographs, moving-pictures, and by actual trenches on the ground, on the methods of obtaining a lodgment in the hostile trenches by means of the grenade; and practice running along and climbing out of fire and communication trenches with full equipment, including bags or baskets of grenades. As a basis for subsequent squad instruction include explanations of the best points of attack; the means of supply of grenades, methods of carrying, and depots established; necessity of silence during the operation, communication by signals, etc. Extend this instruction and practice to the methods of clearing the enemy out of trenches by means of grenades, after a lodgment has been effected; the methods of examining shelters; the advance from traverse to traverse; barricading; blowing in trench walls, etc.

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XIII. Nomenclature and Technical Use.

A. EXPLOSIVE GRENADES.

1. **Fuse Grenades** { defensive { Grenade Model 1915 F1; Grenade Model C. F. } offensive Grenade Model 1915 O. F

2. **Percussion Grenade.** Used only for trench mortars.

1. **Grenade Model 1915 F.1.**

Consists of a cast iron oval shaped body with exterior serrations to facilitate fragmentation.

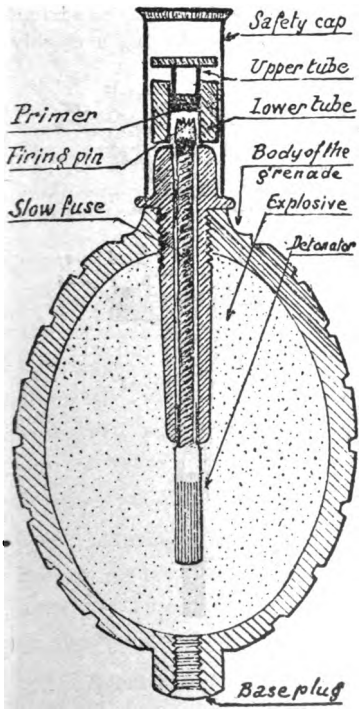

Fig. 44.

The primer-plug is screwed into the body.

Primers in use are as follows:

Metal primer model 1915.

Automatic primer, model 1916, B.

The second is intended to supercede the first.

A. Metal Primer, Model 1915. (Fig. 44).

1. **Description.**—It consists of a lead and tin tube at the lower end of which is a slow fuse covered with a detonator. At its upper end an igniting outfit consisting of two concentric tubes sliding one over the other. At the bottom of the upper tube a priming piece; on the extreme end of the lower tube one notch of the striker.

A cap or spindle assures protection to the lighter.

2. **Lighting.**—Take the grenade with the right hand, withdrawing the cap. Strike the upper tube against a hard object, releasing it immediately.

The burning of the primer lights the fuse which burns

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in five seconds. At the end of this time the grenade explodes.

Throw all grenades when lit, even if there are signs of non-grains of cheddite.

3. **Remarks.**—Explosive discharge, 2 ounces, 50.8 grains of cheddite.

Total weight of the grenade when ready for firing, 1 lb., 5 oz.,

Length of burning, 5 seconds. Average range, 30 yards.

Automatic Lighter, Model B (Fig. 45).

1. **Description.**—The automatic lighters have a cylindrical shaped body in which is enclosed a slow fuse, having a closely

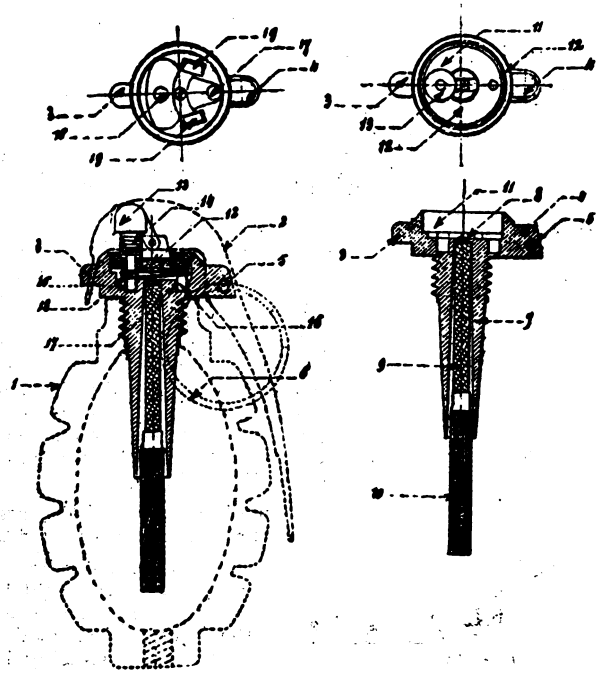

Fig. 45.

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crimped detonator, (10) at its end. The top of the lighter has a large groove (11) in which to insert the lighting fuse.

A lock (13) passing through the cover, gets between the two arms of the spring catch and keeps them in place. This lock is forced upon by a spring (14) placed outside and above the cover, the lock is kept in place by the releasing lever (2) which is fixed on one extremity, to a bolt (13) and on the other by means of a safety pin, (provided with a ring. (5 and 6).

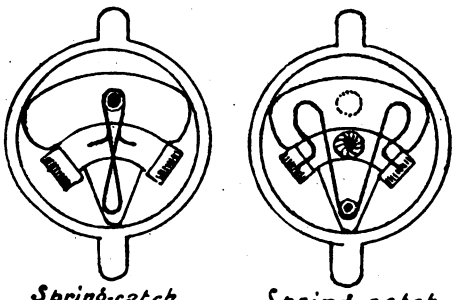

Fig. 46.

The safety pin is withdrawn by pulling on the ring. When the grenade leaves the hand the striker lever is lifted up by the lock which goes off the pressure of its spring. Consequently the primer-like percussion spring being free relaxes and strikes the two primers. The flash produced by one of these primers is quite sufficient to light the safety fuse. (Fig. 46).

2. **Lighting and throwing.**—1. Hold the grenade in the hollow of the right hand, primer up, the ring turned in and near the base of the thumb, the lever is then in the palm of the hand and may be held firmly without effort. (Fig. 47).

3. **Remarks.**—1. Hold the grenade well up toward the prim-

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er so as to hold the lever firmly in position. Do not remove the pin until just before throwing the grenade. After removing the pin keep the hand closed but not clenched. The effort necessary to hold the lever down is slight, but must be continuous while the grenade is set at "ready."

Fig. 47.

2. **It is forbidden to set off the fuse of a grenade before throwing under pretext that the match requires so long to burn.**

3. Bomber must avoid continuous holding of a grenade at "ready," and must particularly avoid walking as a false step might cause him to let it fall. Normally the raising of the end of the lever about 1 inch will cause the grenade to explode. In the process of manufacture this distance may be perceptibly reduced. Therefore, the hand should be kept tightly closed and no attempt made to test the working of the lever. The bomber will soon learn that this weapon may be handled both safely and easily, provided he does not take chances.

Fig. 48.

Should the grenade fall by accident, he must keep calm, pick it up quickly, and throw it before it explodes.

3. By developing the presence of mind in his bombers an instructor may avoid many accidents caused by carelessness. Each one should be required to practice throwing an empty grenade on the ground and then to count the second aloud. By the time he has counted 5 the grenade must have been picked up and thrown, and the entire personnel must be under cover.

4. Charge of the explosive, total weight, average range, length of burning, transportation and mounting. Like the metal primer model 1915.

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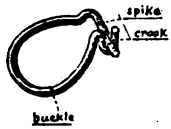
C.—Grenade with Safety Pin.

To remedy the accidents which have been inflicted by the automatic lighter. Model 1916 a security bolt has been ajusted which insures rough handling and transportation of grenades in bulk.



This safety in is made of a ring.

One of the ends of the open ring forms a rectilinear wire which passes through the lever of the grenade and which constitutes the bolt pin.

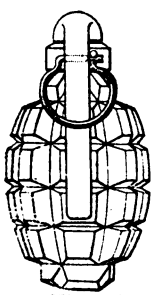


Fig. 49.

On the other end of the wire, a hook which prevents it from coming out. When the ring grenades are well hooked, their transportation is easily assured and without danger, 12 can be safely carried.

To throw a grenade, grasp same with right hand, insert index finger of left hand in the ring, pulling so as to disengage hook from extremity of the wire. This done, pull the ring to one side to release safety pin.

In this last movement, the ring is partially opened and the hook passes, without difficulty, over the release lever.

After some practice, the two movements can be combined, but at the start it is proferable to have two distinct counts.

II. American Ignition Plug. (Fig. 49a and 49b).

I. Description.—The American ignition plug adjusted to a grenade body, having the same shape and weight as the F1 grenade, comprises a cast-iron and tin body, in which is found a time fuse with a detonator at its end.

In the top of the time fuse is placed a primer, which is protected against dampness by a coating of paraffine.

On the axel bolt, on the side of the ignition plug a spring is adjusted which checks the action of the striker. The contraction ofthis spring and striker is held by the help of the

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top of the releasing lever; which can circulate around a lever bolt. The releasing lever is held in place by a notch etched in the safety cover which also protects the ignition. A safety pin retains the safety cover in place and assures complete security.

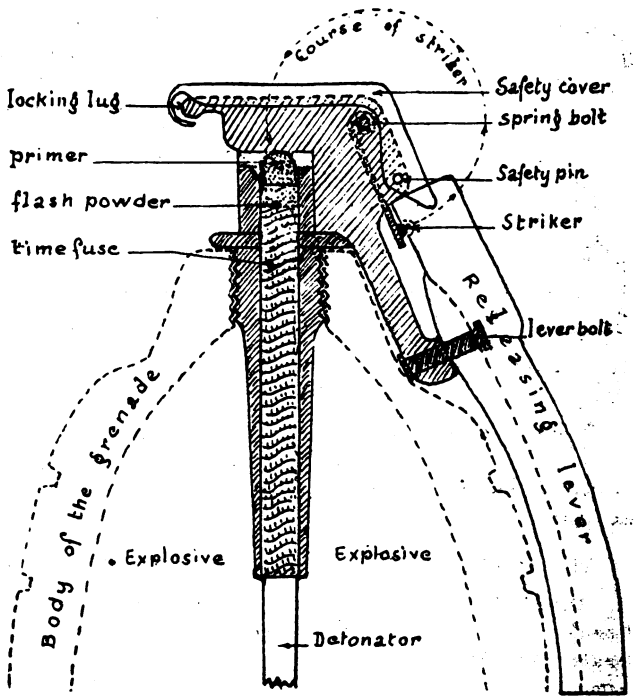

Fig. 49a.

II. Lighting and Throwing.—Grasp the grenade in the right hand, the thumb holding the lever, rest the hand on right hip and withdraw safety pin.

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Throw the grenade according to principles given above. When the grenade is released from the hand, the friction of the lever against the thumb is sufficient to displace the lever from its position.

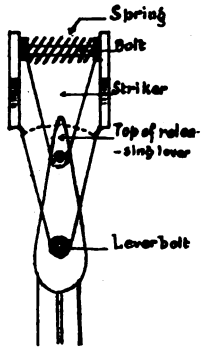

Fig. 49b

While turning around the lever bolt the top of the releasing lever is thrown out of its position of rest against the nose of the striker. The releasing lever, pushed by the force of the contracted spring, then completes its course; that of rotating around the bolt; the point then strikes the primer which lights the flash powder and time fuse.

III. **Remarks.**—The bomber, after having withdrawn the safety pin can lay this grenade down near him, while British and French grenade primer plug are different and do not permit this; not automatically priming themselves when they are released from the hand of the thrower.

2. Grenade Model C. F. (Citron Foug) (Fig. 50).

1. **Description.**—The grenade has a cast iron body (1) with exterior grooves, lemon shaped, closed with a wooden plug, (2) containing a lighting system.

The time fuse (3) is ignited by the percussion of a primer, (4), placed between an anvil (5) and a striker-point (6), ordinarily separated from the primer by a special spring (7). This spring is supported by the head of the striker on a metal ring-washer (9) covering the wooden plug. The fire of the

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primer is transmitted to the fuse through the central-canal of the anvil, and produces the explosion of the detonator and of the grenade. A protecting cover (10) is fastened to the body with waterproof coating for the striker and keeps the primer from being affected by humidity.

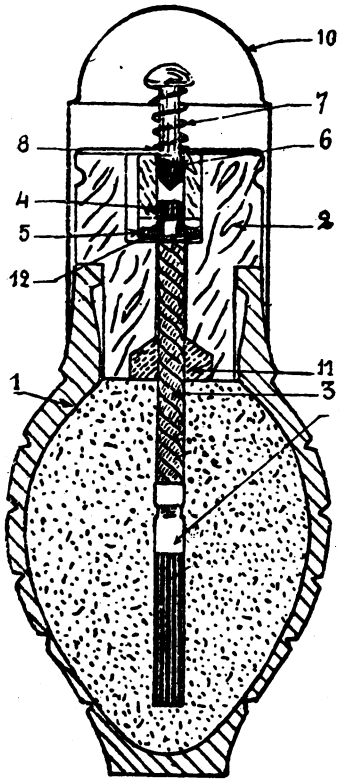

Fig. 50.

11, joint; 12, spring buffer.

2. **Lighting:**

1. Take the grenade in the right hand, and strike head of striker on a hard object or on the body of another grenade held in left hand. This shock ignites the grenade and smoke is admitted through the air hole in the cork.

2. After the shock, throw the grenade without switching it from one hand to the other. Throw the grenade even if same should per chance fail to emit smoke.

4. **Remarks.**

Total weight of the loaded grenade, 1 lb., 4 ounces.

Charge of explosive, 3 ounces.

Length of burning, 4 to 5 seconds.

Grenades are transported already loaded and primed, in cases of 20.

Never uncap the grenades beforehand so as to avoid the air-hole being closed up.

2. Uncovered grenades, in trenches, and not used, will be recovered and sent to the "Parcs des Grandes Unites," to be destroyed.

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3. Be careful, before each throwing exercise to examine the condition of grenades, especially see that the air-hole is not blocked.

4. The forming of barrage fire with C. F. grenades is the same as with F1 grenades.

3. **Offensive Grenade, Model 1915, O. F. (Fig. 51 and 52).**

1. **Description.**—Avoid shaped tin body, 0.118 inches thick. Use the same primer-plug as for F1 grenades, (metal primer or automatic primer).

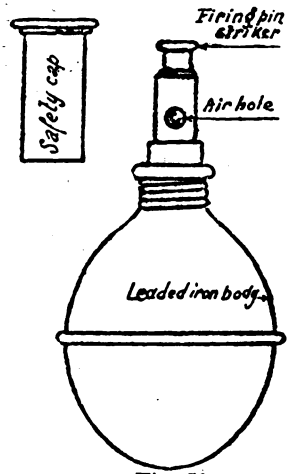

Fig. 51.

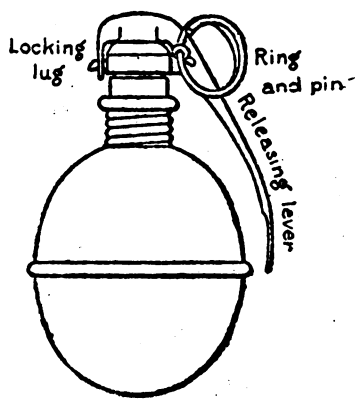

Fig. 52.

2. **Lighting.**—The O. F. grenade is lit and thrown by the same method as the F1, as it is provided with the same lighter.

3. **Remarks.** 1. Total weight of the loaded and primed grenade, about one-half pound.

Charge of explosive, 5 ounces.

Length of burning, 5 to 6 seconds.

Shipment in separate cases, 200 grenades or 500 primer plugs.

All soldiers must be able to make a defensive barrage at

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35 yards distance at an average of 1 man each 10 yards interval with O. F. grenades.

General Remarks on Fuse Grenades.

It sometimes happens that the explosion of a fuse grenade will not occur at the normal time (5 to 7 seconds). For purposes of instruction it is best to wait 12 to 15 seconds before coming to a conclusion of a misfire.

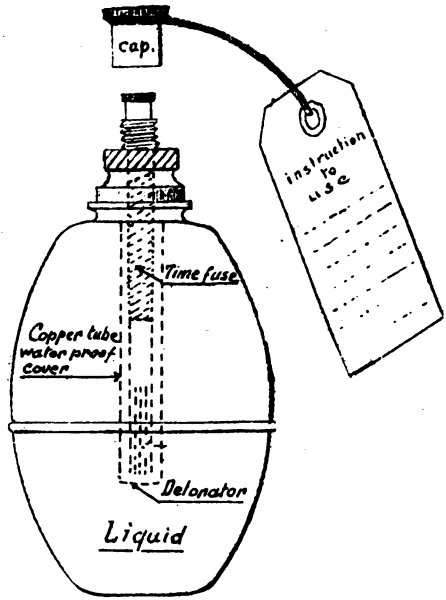

Fig. 53.

These delays are generally caused by too thorough crimping of the detonator on the time fuse. This crimping having broken the train column of powder of the fuse and the fire. Instead of being transmitted rapidly by the powder, it is transmitted slowly by the wick thereby causing delay.

(B) Suffocating, Intoxicating and Tear-producing Grenades.

Little or non-intoxicating grenades whose component ingredients are, chloride, bromine, anhydride of sulphur and nitric acids, but can render closed or poorly ventilated areas untenable.

Suffocating grenades are composed of formic acid, benzyle bromide, and bromacetone.

It is necessary to use them cautiously and judiciously to compel the enemy to evacuate his dug-outs, and various places of shelter.

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I. Suffocating Grenade, Model 1916. (Fig. 53).

1. **Description.**—Oval shape, made of lead, the primer plug or automatic lighter model 1916 of the grenade F1. The detonator is in fact the only explosive.

2. **Lighting.**—For igniting see model F1. Can be thrown 40 yards without danger in an open field.

3. **Remarks.**—Avoid throwing against wind, which would cause the return of suffocating vapors.

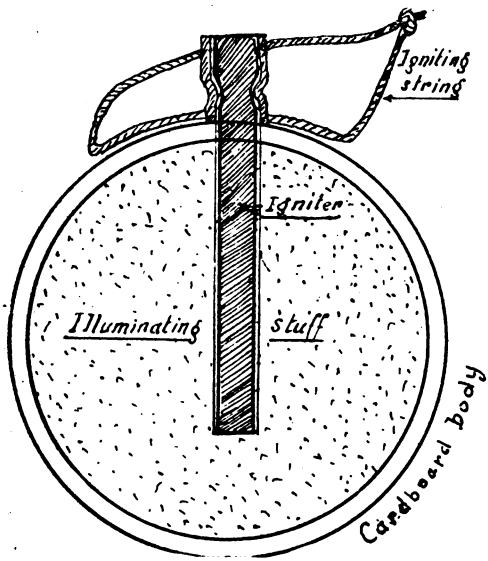

Fig. 54.

Total weight, 14 ounces.

Transported in cases of 25, all loaded. Automatic plugs are carried separately.

Weight of special liquid, 7 ounces.

Total weight, Approximately 14 ounces.

Average range, 30 to 40 yards.

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C. Lighting Incendiary and Smoke-Producing Grenades.

I. Lighting Grenades. (Fig. 54).

To illuminate the field in a close attack, to surprise an audacious patrol.

These weapons are composed of a cardboard rocket, 2.5 inches in diameter, weiht, 9 ounces with a time fuse with its exterior extremity crimped in a brass tube, containing a phosphorous primer.

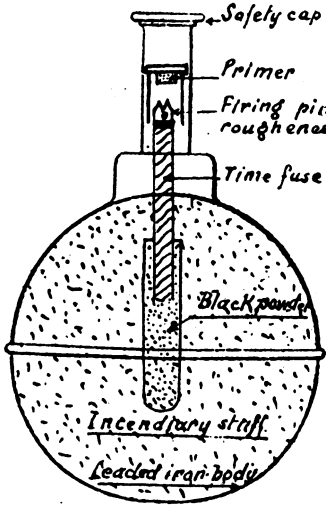

Fig. 55.

The grenade is filled with an illuminating chemical composed of magnesium powder or of aluminum and iron sesquioxide. The paper is varnished black. The lighting is made by a scratcher held in the left hand.

This rocket-grenade is thrown with the hand. It illuminates very extensively for about a minute and a half, within a radius of 20 yards.

II. Incendiary Grenades.

To ignite combustible objects, sufficiently dry, clear a rifle range from straw, bushes, underbrushes, etc. The debris is used by the moppers up of trenches to set fire to shelters, and to the sheltered personnel. Thus a smoke producing effect is produced. They are composed of phosphorous, chloride of sulphur, gasoline and petroleum.

(a) Incendiary Grenade, 1916 A.B. (Old Model), (Fig. 55).

1. **Description.**—It is at the same time incendiary and smoke-produsing. Spherical body, made of tin, porcussion metal primer-plug. At the bottom of the central tube which holds the lighting primer, place a small quantity of black powder, which at the same time favors explosion of the spherical tin body, and the lighting of the material which is made of white phosphorus mixed with carbonized sulphur.

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2. **Use.**—For the igniting and the throwing of this grenade see grenades 1915 F1.

Avoid throwing against the wind. The smoke emitting therefrom is very thick, and dense, but not asphyxiating. It forms an excellent screen, useful when launching attacks to mask certain activities.

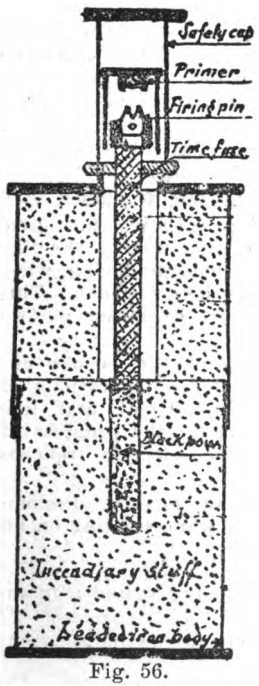

Fig. 56.

3. **Details.**—Total weight, 1 lb., 9 ounces.

Weight of special material, 1 lb., 1 ounce.

Average range, 25. to 35 yards.

Avoid throwing against the wind. Use for mopping up shelters or to defend barricades when the wind is favorable.

(b) Incendiary Grenade with Automatic lighter. Model 1916 (New Model).

1. **Description.**—Composed of an oval shape body made of tin, same as the suffocating grenade 1916 model. Loaded with white melted phosphorus, and containing an automatic lighter, 1916 B model without detonator. The explosion of the grenade is obtained, by the aid of a charge of black powder, contained in a tube on which the primer is screwed.

2. **Use.**—Same as the automatic lighter grenade model 1916.

3. **Details.**—Transported in cases of 50, already charged and primed. Do not unscrew the primer-plug.

Weight of special material, 11 oz.

Total weight, approximately 16 ounces.

Average range, 30 yards.

(c) Incendiary Cylindric Grenades., Model 1916. (Fig. 56).

1. **Description.**—Composed of a cylinder box, made of tin, loaded with calorite (powder of aluminum substance mixed with

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metallic oxid, generally iron oxide), and of a lighting primer of a grenade model 1915 F1. It is used to burn combustible materials, or to destroy by melting metal objects, motors, tanks, guns, etc. Heat produced is about 5,400 degrees Fahrenheit.

Fig. 57.

2. **Use.**—Detach the protecting cover of the primer, strike this primer against a hard object, and place the grenade on the object to be destroyed or burnt. Five seconds after the charge is set on fire without exploding, and the calorite runs out piercing the cover of the grenade.

3. **Details.**—Shipment in cases containing 25 loaded grenades.

(d) Smoke Producing Grenades.

Strictly speaking they are not grenades, but cylinders or tarred sheeting filled with hydrocarbon, producing, when burning, dense and heavy smoke. This cylinder is set on fire by means of two slow fuses.

The weapons are used to smoke out shelters, to dissimulate preparations or initial attacks, to stake-out first line trenches for a troop in the progress of advance, and in the enemy's trenches during an attack.

Used to smoke out shelters, dissimulate preparations or when starting on an attack.

Two Types:

(a) Smoke producing cylindric grenade, Model 1888.

(b) Smoke producing cylindric grenade, Bouchet Type.

(a) **Model 1888. (Fig. 57).**

1. **Description.**—A cardboard tube, containing fumigating chemicals primed with a fuse tube at the extremity of which is a friction primer.

It has on its upper end a wooden plug with three channels, permitting the smoke to be set free.. This cylinder is proved to be air tight by means of a tin envelope, which also allows a good conservation.

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2. **Use.**—Uncover the cylinder, placing it in a vertical position, primer upward, and ignite the priming fuse.

3. **Details.**—They are carried to the troops in cases of 50, standing on end, primer up, in 10 rows of five each.

(b) Smoke Producing Cylindric Grenades, Bouchet Type. (Fig. 58).

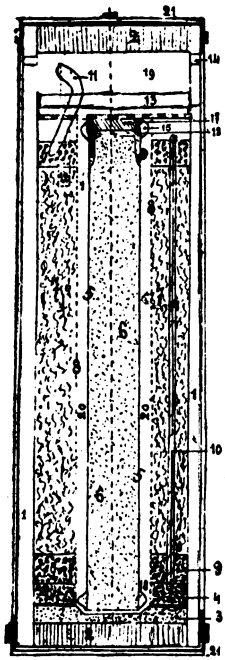

Fig. 58.

1. **Description.**—Composed of a cardboard cylinder, perforated on one end. This cylinder contains 9 ounces of fumigating mixture, composed of metal-salts, trichloride of antimony, chloride of aluminum and 40 ounces of combustible material such as

Lighting is affected by a small time fuse, 6 inches long, at the end of which is a lighting apparatus, a small metal cap, designated to protect the fuse from humidity.

At the other extremity are 2 pieces of the time fuse notched in, in such a way that the fuse is buried in the upper layer of the primer.

The grenade is 13 inches long and 4 in. in diameter; weighing 6 pounds. The length of smoking is about 2½ minutes.

A parafined paper envelope covers the whole and enables the grenade to be exposed several hours to rain.

2. **Use.**—Pull on end of the rope, the covering tearing, uncovering the grenade.

Withdraw metallic cap, and recovering the primer.

Lay grenade down, raising its upper end where air holes are.

Light primer.

Under ordinary conditions, even in a strong wind, place the grenades at intervals of 2 yards to obtain cloudy effects.

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CHAPTER II.

British Grenades

A. Organization.

1. In the British Army the Infantry Bridage is usually composed of 4 Battalions. Each Battalion has 4 Companies. Each Battalion disposes of a Bombers platoon divided in 4 groups of 8 Bombers each and in addition at least 32 auxiliary bombers.

2. The 4 platoon squads in a company form the company bombers, and must be trained to work together . In the trenches the company bombers are disposed of by the company commander as required, according to the scheme of defense laid down by the battalion commander. Squads should, however, remain with their own platoons as far as possible.

In addition, if desired and approved by the divisional commander, a separate battalion bombing platoon under the battalion bombing officer. consisting of not more than four bombing squads, may be formed and administered as a separate unit. If this organiation is adopted, is should be universal throughout the division.

For purposes of training in the actual technique of bombing, the company squads may be grouped together under the battalion bombing officer when the battalion is in rest billets, but they must train with their companies when company training for attack and defense schemes is in progress. For any particular operation, e. g., a raid or general attack, when a special organization of bombers becomes necessary. a proportion of the company bombers may be withdrawn and specially trained under the battalion bombing officer for employment in the impending operation. The normal operation should be resumed when the operation is over.

Men employed as bombers must not be allowed to lose their efficiency in the use of the rifle and bayonet, or in the ordinary duties of the infanty soldier.

3. Squads of one non com's and eight men will normally comprise two bayonet men, two throwers, two carriers (re-

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serve throwers), one rifle grenadier, one spare man (sniper or rifle grenadier) and the leader (non com's). The squad may be divided into two groups if necessary.

Every member of the squad should be thoroughly trained in the duties of every position, so that he can take any place in the squad. If this is done the composition of the squad can nbe varied to suit circumstances.

4. Each platoon in a battalion should have a specially trained bombing squad of one non com's and eight men, and should train sufficient reserves to replace casualties and maintain the squad at full strength.

Each brigade has a Bombing Officer, who supervises the training of bombers in a brigade, holds periodical grenade exercises of a more advanced nature, and generally assist battalions. His chief duty in action is to insure a supply of grenades to battalions. He is assisted by a sergeant, who should be a thoroughdly experienced bomber.

(B) Nomenelature and Technical Use.

Mills' Hand Grenade. (Fig. 59).

1. **Description.**—Cast iron, serated to provide numerous missiles on detonation. Into one end is screwed a center piece with separate recesses for the striker and the detonator. (Fig. 60)

The striker is kept cocked against its springs by its head catching on the end of the striker lever when the latter is lying against the body of the grenade.

The lever is retained in this position by the safety pin.

Igniter.—This is a separate unit, consisting of cap, cap chamber, safety fuse, and detonator (No 6 which is 1⅝ inches long, No. 8 being 2⅛ inches).

On withdrawal of the safety pin, the lever swings outward under the pull of the striker spring, thus releasing the striker and then fires the detonator.

Weight, 1 pound, 7 ounces.

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II. Use.—To prepare for use:

1. Examine the safety pin and see that it is easy to withdraw.

2. Unscrew the base plug and insert igniter.

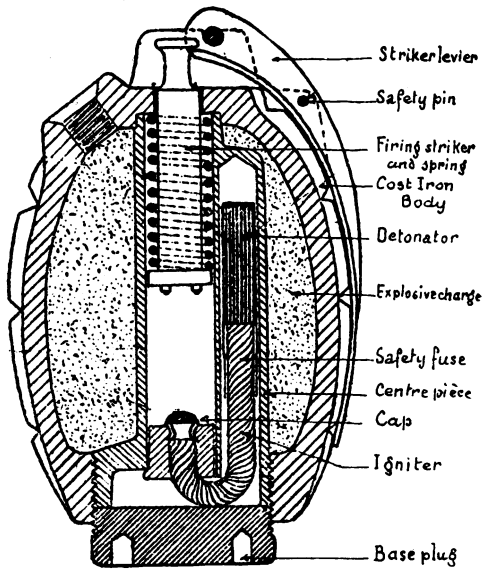

Fig. 59.

3. Screw in the base plug with the key provided, taking care that it is screwed home. The lead base plugs which are sometimes supplied must be screwed in with care, otherwise the projections may be injured.

To throw:

1. Hold the grenade in the right hand in such a position that the lever is held securely against the body of the grenade by the fingers, with the lever along the second joints on the fingers.

2. Withdraw the safety pin with the left hand, using a hook if preferred, still keeping a firm grip on the lever.

3. Throw the grenade.

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Special Precautions:

1. Do not release the lever before throwing the grenade.

2. It is essential that the lever should be held securely against the body of the grenade, otherwise the collar which holds back the striker may release and so ignite the fuse.

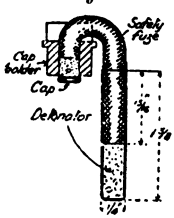
3. The precautions against using grenades as filled grenades after they have been used as dummies for practice is particularly applicable to this type.

4. Before inserting igniter see that the safety pin is not broken or badly corroded, and that the fuse is not cracked or damaged, as these defects may accelerate time of burning.

III. Details.—The following points should be noticed:

1. That there are two striking points on the perimeter of the lower end of the striker, and not one central point. A central point as used in Stoke's mortar bombs will cause a premature explosion in a Mills grenade.

2. That the safety split pin is not broken or badly corroded and that the ends are correctly splayed, so that the pin can not be jolted out, but yet is not too difficult to withdraw.



3. That the jaws of the lever are a good fit and hold the top of the striker correctly.

4. That the wax seal around the top of the striker is unbroken.

5 That the mouth of the detonator is closely crimped except through the fuse.

6. That the fuse is in good condition and not cracked or damaged by being bent, and is not loose in the cap.

Fig. 60.

It has been found by experiment that no danger attaches to the partition between the recesses for the striker and the detonator being thin or holed. Even with the partition completely cut away no permatures have taken place.

Mills's grenades for use as rifle grenades must have solid, and not recessed, base plugs.

Packing.—The grenades are packed 12 in a wooden box, with a cylinder containing 12 igniters.

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CHAPTER III.

German Grenades

(A) Tactical Employment.

(Translation from a German Document).

The Bombing party operates as a unit, chiefly in the trench itself, its action being both offensive and defensive, the manner in which it should be stationed and distributed, employed, armed, led and safeguarded, must be regulated accordingly.

Men selected for this work should be courageous and expert hand grenade throwers. They should wear a distinctive badge. In each platoon there is a bombing party consisting of six men including their commander. When one of these men is killed, a substitute should be ready to replace him. The bombing party should be stationed approximately in the centre of the platoon. Boxes containing grenades should be placed near the party; they should be clearly marked as containing grenades and should be reserved for the use of the party in the first instance.

(a) Should the enemy have penetrated into a small portion of the trench, and should the troops on the spot not be able to deal with him by means of the bayonet or hand grenades, the bombing party should, without waiting for orders, immediately attack the enemy with grenades before it becomes necessary to erect a barricade in the trench. On a signal from their Commander, the men of the bombing party equip themselves with hand grenades and gather round him.

All men of the party carry their rifle slung, bayonets fixed and daggers ready, with the exception of the two leaders who do not carry rifles. The latter carry as many grenades as they can conveniently handle and should, if possible, be armed with pistols. The Commander, similarly armed, follows the two leading men. If no pistols are available, the Commander, who should cover the two leading men carries his rifle ready loaded in his hands. The remaining three men follow the others a traverse in the rear: they keep within sight of their commander, and carry as many grenades as possible. When possible the grenades are carried in their boxes. The two lead-

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ing men advance along the trench in a crouching position, so that the Commander can fire over them. The interval between traverses is crossed in rushes.

(b) If the enemy has penetrated into the trench with a large force and a continuation of his attack is to be expected, as good a barricade as circumstances permit should be erected. The bombing party should at first remain on the defensive in rear of this barricade or behind a breatwork. Rifles should be unslung and ready for use. The Commander and the three rear men should take up their position behind the nearest traverse and within sight of the two leading men.

Bombing parties belonging to the platoon in support and in reserve should be stationed somewhere in the vicinity of the approach trenches, and should be brought up to a strength of eight men including the Commander.

(B) Nomenclature and Technical Use.

General Remarks.—German hand grenades which have been found are of two types: Those which have the appearance of service articles and those which are obviously improvised. With the latter, great care is invariably taken to protect the charge from damp, and to render it flashproof by waxing, etc.

The hand grenades are both time and percussion. With the former, the time of burning is about 6 seconds, and the fuse is ignited by one of the following methods:

1. Spring striker and cap.
2. Friction tube.
3. Match-head lighter.

Attached to fuse and detonator.

Precautions.—The following precautions should be taken with any grenades that may be found or captured:

1. The grenades should be examined at once by a bomber, in order to find out whether they are live, how they are fired, etc.

2. The means of firing will probably be immediately apparent to a trained bomber, but during examination grenades should be handled with care.

3. No man who does not understand grenades should touch them, but should report the presence of grenades to the nearest bomber, N. C. O. or officer.

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4. When used against the enemy, a grenade should be thrown as soon as it is "lit," even if there is no apparent evidence of the fuse burning.

5. Arrangements for removing, storing, or destroying grenades found in a captured position should be made as soon as possible by bombing officers.

6. Bombing officers will also be responsible that, when samples of grenades are taken back to headquarters for examination, the grenades are not in a dangerous condition, and the detonators have been removed.

Nomenclature.

1. Spherical hand grenade.
2. Cylindrical hand grenade with handle (time fuse).
3. Cylindrical hand grenade with handle (percussion).
4. Disc hand grenade.
5. Egg hand grenade.

1. SPHERICAL HAND GRENADE. (Fig. 61).

I. Description.—Spherical, about 3 inches in diameter, made of cast iron about one-third inch thick, and is filled with black powder or other explosive which does not require a detonator. The body is coated with varnish inside and out.

II. Use.—The means of ignition consist in a combination of friction tube, lighter and fuse. The friction tube is fired by pulling out the wire in the direction of the axis of the tube. A wrist strap with a swivel hook is usually provided for this purpose. Time of burning, seven seconds. A similar lighter which burns for five seconds is also provided. It is distinguishable by the head of the fuse being painted red.

Safety arrangements.

1. Grenade and fuse kept seperate during carriage.

2. The vent for the fuse in the grenade is closed by means of a zinc plug.

3. The wire is bent in order to prevent a direct pull.

III. Details.

1. Weight, 1 pound 10 ounces.

2. Unscrew the plug of the tube, marked "S," opposite to the safety pin.

3. Remove detonator.

Warning:

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Blinds are dangerous. As soon as any part of the safety pellet projects there is chance of detonation.

4. The red grenade to be found in every box is a dummy for practice.

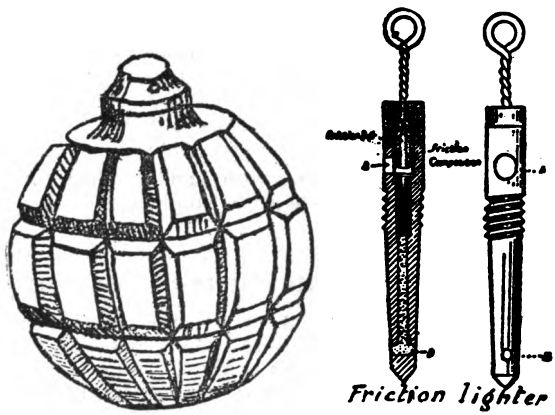

Fig. 61.

2. Cylindrical Hand Grenade with Handle and Time Fuse. (Fig. 62).

(Stielhandgranate B. Z.)

I. Description.—Tin cylinder, 4 inches by 2⅞ inches diameter, containing a cartridge of explosive. The full charge is 300 gr. (10.5 oz.), but part of the space is sometimes filled by a wooden block.

The top is closed by a lid held in place by four clips; at the bottom there is a screw-threaded hole to take the handle. The bottom of the cartridge is fitted with a paper tube for the detonator. On the side of the body there is a hook, by means of which the grenade can be attached to the belt.

The inscription on the body, "Vor Gebrauch Sprengkapsel einsetzen" means "Before use insert the detonator."

Handle.—Wooden, about 9 inches long, with a metal top screwed to fit the body. It is bored axially to take the igniter

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and wire pull. In the latest pattern a screwed metal cap is fitted to the end, which protects the string loop attached to the wire pull.

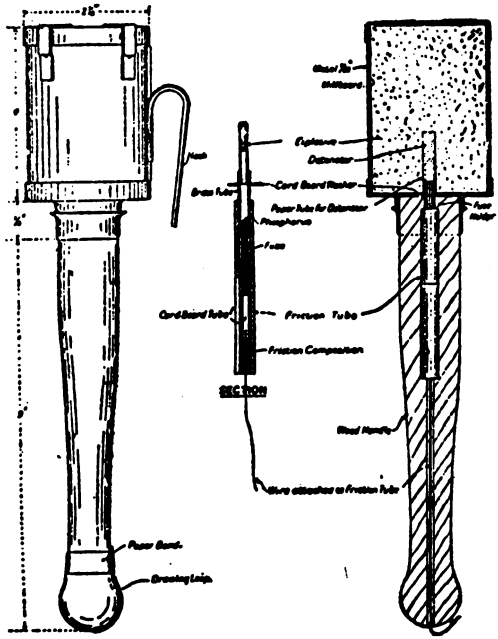

Fig. 62.

The means of ignition consist of a friction lighter and safety fuse, contained in a cardboard tube. The igniter is actuated by pulling a string loop at the end of the handle. This loop is attached to the wire pull of the friction tube. In the old pattern the string loop is fixed to the handle by means of a paper band, but in the new pattern a porcelain button is attached to the loop in order to afford a better grip; a hollow is formed in the end of the handle and covered by means of a screwed metal or cardboard cover. When issued the string loop and button are coiled up in the hollow and

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are protected by the cover. The mouth of the detonator fits into a brass tube at the top of the igniter, and is fired by the flash from a dab of phosphorus at the end of the safety fuse. Time of burning, 5½ or 7 seconds, as marked on the handle.

Safety arrangements:

1. The grenade and detonator are kept separate during carriage.

2. The string loop is either attached to the handle by a paper band or contained in a metal or cardboard cover. The paper band or the cover should only be removed just before firing.

Weight, 1 pound, 13 ounces.

II. Use.—To prepare for use:

1. Unscrew the handle and see if the detonator is in position; if it is, refix the handle.

2. Hold the grenade in the right hand.

3. Tear off the paper band with left hand or unscrew the metal cover, or remove cardboard cover, as the case may be.

4. Pull loop or button with left hand.

5. Throw immediately.

If the detonator is not in position, search should be made for a supply of the proper detonators. Fit the mouth of the detonator into the projecting brass tube, screw in the handle, and then proceed as in 2, 3, 4, and 5 above.

III. Detail.—To render useless:

1. Unscrew handle, remove detonator.

2. Pull string loop, which will light the fuse, and throw handle away.

3. **The red grenade found in some boxes is a dummy grenade without fuse, detonator, or exploder.**

3. CYLINDRICAL HAND GRENADE WITH HANDLE (PERCUSSION), (Fig. 63).

(Stiel or "Wilhelm's" Handgranate, Az.)

I. Description.—This grenade is similar in general outward appearance to the "jampot and stick" grenade (time fuse), just described. The differences are:

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1. The end of the handle (see below), which may have a wire loop projecting from it.

2. The diameter of the cylinder is 1 inch greater than that of the time-fuse pattern.

3. It has no hook on the side of the cylinder.

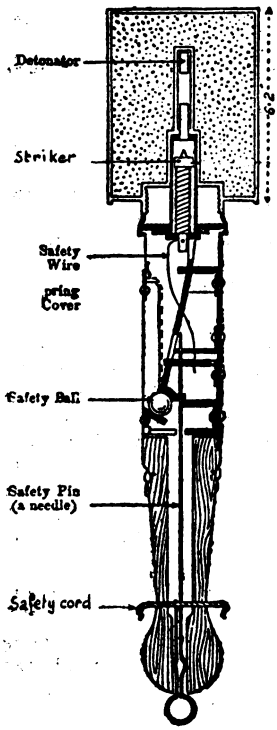

Fig. 63.

Body.—Tin cylinder, 4 inches long (marked 6.2 inches in one drawing, though it only scales 4 inches) by 3⅞ inches in diameter. It contains a cartridge of 7 oz. according to one account, 15.8 oz. according to another, of explosive. The top is closed by a lid; at the bottom there is a screw-threaded hole to take the handle. The bottom of the cartridge is recessed and lined with cardboard to receive the detonator, etc.

Handle.—Partly metal and partly wood, about 9 inches long. The metal top contains the firing arrangements and is screwed to fit the body. The wooden part is bored axially to take the safety pin. In one description the loop of the wire safety pin projects from the end of the handle, in the other there is a weight attached to the end of the pin which is secured in a metal screw cap on the end of the handle.

Action.—This is not quite clear from the plate. It is described as follows: The firing arrangement consists of a striker and a safety device. On throwing, the safety pin is withdrawn by the weight flying out in one pattern, by hand in the other; the spring cover then flies off and withdraws the safety wire from the striker bolt, which is then only held by the ball and the flat spring. On striking the ground ,the ball and flat spring fall out from their seatings; the striker bolt is therefore free, and is driven by its spring on to the cap.

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Safety ararngements:

1. The grenade and detonator are kept separate during carriage.

2. Safety pin and safety wire (as described under "Action").

3. Cord which holds safety pin (or cap which keeps weight secured).

Weight, 1 pound, 12 ounces or 1 pound 5 ounces.

II. Use.—To prepare for use:

1. Unscrew the handle and remove filling from detonator recess.

2. Insert detonator in its place and replace the handle.

To throw:

1. Remove the safety cord (or unscrew the cap on the end of the handle).

2. If there is a loop at the end of the safety pin (and no weight), place the little finger of the right hand in the loop.

3. Grasp the handle with right hand and throw. The arm must be raised high and as much force as possible used, even if the target is near; otherwise the grenade may not be armed.

III. Details.—To render useless:

If the safety pin has not been pulled out, unscrew handle and remove the detonator.

Care must be taken in throwing not to hit the grenade against anything or it may explode.

As long as the safety pin is in the handle, the grenade is safe to handle and it will not detonate if struck or allowed to fall.

Blinds are extremenly dangerous to handle.

4. DISC HAND GRENADE. PERCUSSION.

(Diskus-Handgranate, 1915). (Fig. 64).

There are two patterns one weighing 15 ounces and the other slightly smaller, 13¼ ounces. The former is made of sheet metal and is for throwing in the open; the latter is of cast iron and should only be thrown from behind cover.

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I Description.—Two iron shells, convex on the outside and with the edges either turned over or riveted. It contains two circular bags of explosive, each containing 2 ounces.

The means of ignition consist of six metal tubes in the shape of a star, meeting at the center of the grenade plug. Four of these tubes carry striker pellets with caps at the inner ends, and opposite to each cap is one of the points of a four-pointed star. The outer end of each of these tubes is closed by a screwed plug. One of the remaining two tubes carries the detonator, of which the inner end is open. This tube is closed by a screwed plug with milled head with the letter "S" on it.

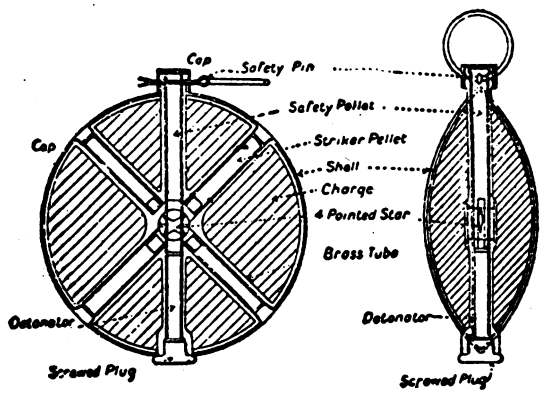

Fig. 64.

Safety arrangement.—The sixth tube contains a safety pellet divided into two prongs, one of which passes on each side of the star and protects the points. This pellet is retained in its position by a cap which closes the outer end of this tube. The cap is secured to the tube either by clips or by a safety pin with ring.

Action during flight.—Owing to the grenade turning over, the safety pellet flies out and the grenade becomes sensitive. When the edge of the grenade strikes the target the corresponding striker pellet drives the cap forward on to the point of the star. The flash passes into the detonator and explodes

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the charge. A low or horizontal throw may cause failure. On detonation the fragments fly out laterally, and not to the front or rear.

II. Use.—To prepare for use:

1. Hold the grenade in the right hand, safety pin upwards.
2. Pull out the safety pin with the left hand.

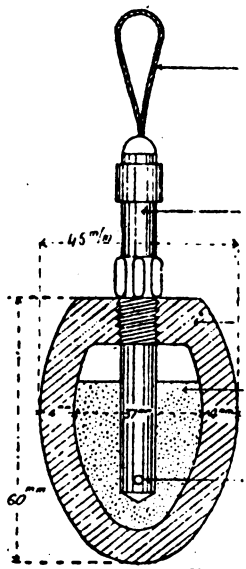

Fig. 65.

3. Pull off the cap and hold the safety pellet in position with the right forefinger. (If necessary, the safety pin can be replaced).
4. Throw the grenade as high as possible, taking care that the edge is vertical.

These grenades can also be thrown with the strap provided in each box, but this method requires considerable practice.

III. Details.— To render useless:

1. Unscrew the plug of the tube, marked "S," opposite to the safety pin.
2. Remove detonator.

Warning:

Blinds are dangerous. As soon as any part of the safety pellet projects there is chance of detonation.

3. The red grenade to be found in every box is a dummy for practice.

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5. EGG HAND GRENADE.
(Eier Hand Granate). (Fig. 65).

I. **Description.**—Cast iron, egg-shaped, about 60mm. (2.3 inches) long by 45mm. (1.77 inches) diameter, with a screwed hole at one end to receive the igniter. It is filled with a special powder which does not require a detonator.

The igniter is a lead alloy tube which screws into the body and contains a fuse; on one end is fitted a metal cap, containing the friction lighter, which is operated by pulling a wire loop either by hand or by a wrist strap.

Two igniters are supplied—No. 1, with 8 seconds fuse for grenades thrown by mechanical means; No. 2, with 5 seconds fuse for grenades thrown by hand.

Safety arrangements: The igniter is carried separate from the grenade; a small lead plug is screwed into the body and must be removed before the igniter can be inserted.

Can be thrown about 50 yards.

Instructions.

II. **Use**—To prepare for use:

1. Unscrew and remove lead plug.
2. Unscrew in igniter.

It is important when screwing in the igniter to keep the grenade upright, so that no powder can get into the screw threads.

III. **Details.**—Weight, 11 ounces, but patterns vary slightly.

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PART II

Rifle Grenades

Miscellaneous.

The use of rifle grenades, when well practised, disperses the enemy and inflicts greater losses than bombardment. For instance, the 2nd of May, 1916, the 28 "Battalion de Chasseurs" at "Linge" suffered a days bombardment of 3,000 shells without the loss of a man. At night, while the soldiers were at supper and speaking of the inefficiency of the German bombardment, a rifle grenade fell into a group of twelve men, killing 4, and wounding 8. Two of the latter died shortly afterwards.

CHAPTER 1. FRENCH RIFLE GRENADES.

Two grenades are used.

Grenade V. B. rifle grenade (thrown with discharger or "tromblon" V. B.)

Grenade D. R. rifle grenade (thrown with "mandrel" D. R.)

I. THE "DISCHARGER" V. B. AND ITS GRENADE.

1. TACTICAL EMPLOYMENT

(A) IN THE OFFENSIVE. One rifle grenadier covers about 100 feet of front. The twenty-four rifle grenadiers of a company throw 250 grenades per minute, at a range of from 250 to 500 feet, making a perfect barrage.

They are used:

IN EXTERMINATION FIRE:

To inflict daily losses on the enemy, to demoralize them, to stop them from carrying on their work.

IN BARRAGE FIRE.

To repulse the enemy in an attack.

IN SUSPENDED FIRING.

To prevent them from repairing damages made by artillery, shelters, and networks.

(a) **Extermination Fire.**—The use of this fire is based on the enemy's knowledge of daily happenings at regular hours. It is indispensable to have an observation service particularly

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well organized. Combining this observation with the study of aerial photos and of firing maps, and information of all kinds, it will be easy to locate the objectives and time when fire will be most efficient.

The enemies' trenches must be very carefully studied as regards its weak points and points where the enemy can be supprised, (look-out posts, entrances to shelters, crossings, approach trenches, etc.)

Rifles must be kept on racks, with the above mentioned places as targets, so as to be ready to immediately fire a grenade, at the slightest indication of the sight of moving objects.

Extermination fire is composed of:

Individual firing, slow and continued, executed by one rifle-grenadier only.
Surprise fire, violent and rapid, executed by a group of rifle grenadiers.

Very frequently it will be of great advantage to group the "dischargers" of a company in batteries of 2 to 6, in charge of a Non-Commissioned Officer.

Slow and continued firing is done during the day, and especially during the night, at certain points such as crossings of approach trenches shelters, latrines, and loopholes of look-out posts.

Surprise firing is executed at the command of the Company Commanders, or platoon leaders.

To take advantage of all favorable occasions, such as reliefs, "fatigue" working parties, a volley fire is used, then "fire at will," and "rapid fire."

This fire depends on the length of time the enemy is exposed.

Return fire must be immediately brought in action and violent concentrations of fire made.

(b) **Suspended firing.**—When extermination firing has as its object the prevention of the enemy from repairing the damages caused by the artillery, the fire is conducted in a slow cadence or in volleys. This is prohibition shooting known as suspended firing.

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Violent and sudden fire executed during reliefs and fatigue work, and which lasts as long as the enemy is in range, it is always followed by a prohibition suspended firing.

(c) **Barrage Firing.**—Combined with the throwing of hand grenades. This fire has as its object to break enemy attacks. It is invaluable when communications have been severed near the enemy's line, renders artillery barrage fire inefficient. The throwing of a few rifle grenades concentrated on an approach trench stops the progression of hostile grenades.

(B) IN THE OFFENSIVE.—Rifle grenades lengthen the action of hand grenades, by permitting to reach a sheltered enemy quite distanced. It helps to prepare a partial assault, to reinforce the artillery, to give partial barrage fire, to cover the flanks of an attack, to participate in the fight in an approach trench.

(a) **Preparation to a Partial Assault.**—The rifle grenades are used during battle, to prepare an assault when the artillery is inefficient or when the objectives are out of range of hand grenades.

In attacks the use of rifle grenade throwers is closely combined with the action of other units in the waves of an assault. (See their position in a battalion for a formation of an attack). (Fig. 39 and 40).

(b) **It takes the place of the artillery.**—In numerous local fights where it is impossible to have artillery held the rifle grenades execute an accurate bombardment on hostile nests who offer resistance.

(c) **Partial Barrier Fire.**—It isolates enemy groups attacked by hand grenades, preventing retreat, and harrassing the arrival of reserves and reinforcements.

(d) **Protection of the Flank in an Attack.**—In attacks executed on a small front, in raiding parties, groups furnished with rifle grenades can be advantageously used to cover the flanks.

During an important attack, this situation will frequently be used in detailed offensive actions necessitated by the capture of different strong holds.

(e) **Struggles in Approach Trenches.**—The rifle grenade is used with advantage to entangle at a great distance enemy supplies of grenades and to prevent their retreat. The rifle grenadier follows immediately the groups of bombers and automatic riflemen.

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(f) **Protection Against Counter Attacks.**—Principle: a counter attack is stopepd by units well protected and able to immediatly furnish powerful fire.

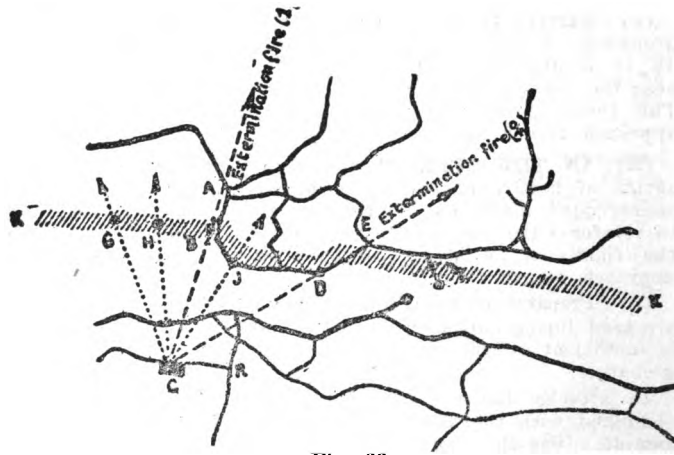

Fig. 66.

To this effect the rifle-grenade is an extremely efficient weapon, when well aimed, properly adjusted and executed by well-trained parties on an enemy grouped for attack, excellent results will be obtained.

Whatever the situation may be, but more particularly in the offensive, it is always of great interest to use the rifle grenade by concentration of fires.

(C) Locations for Rifle Grenade Battery Emplacements.—Barrage fire is made by combining the use of rifle grenades and hand grenades for the purpose of repulsing hostile attacks.

This kind of fire is important when our communication with the rear has been broken or when the proximity of hostile trenches renders artillery barrage fire ineffective. Illustration 66 is a part of a firing map. The captain traces upon it the hachured line K K as the line upon which he wishes to bring a barrage fire with the rifle grenades. This done he notices that a part of the hostil trenchAB will be enfiladed by a group of rifle grenades posted in the middle trench at C. **The plan**

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shows that C is 45 yards from R a thrown junction. He also observes that from C the part of the trench D E can be enfiladed. This wall form a second target. Other groups of the company will be posted in view of similar considerations.

The part of the barrage which falls to four grenade firers posted at C, calculated with reference to the front of the company G J, gives 33 yards for each firer to cover. The captain then marks the points G, H, B, and J 6 millimeters (one-fourth inch) apart. He then measures with his scale the distances C G, C H, C B C J, C D, and C E and ascertains the azimuth angles of their directions. He makes in this way a sketch containing complete firing data for the rifle grenade group at C. It includes:

(a) For all of the grenade firers, for their first fire, a common azimuth C A; all ranges from 100 yards to 150 yards, in order to bring fire upon the whole line B A.

(b) For the second fire, a common azimuth C E; all ranges from 120 to 175 yards in order to cover B A.

(c) For each firer, an individual barrage fire with a given range; for the firer on the left it would be azimuth C G and range 110 yards. For the others, azimuth C H and range 100 yards, azimuth C A and range 100 yards, azimuth C J and range 80 yards.

The rifles are placed on supports and laid with a compass and plumb in the desired direction and elevation. Each firer should understand clearly what he is to do at the command, "**first extermination fire,**" "**second extermination fire,**" or "**barrage fire.**"

(D) Action of R. G. in the Attack of a Strong Point.

(Fig. 67)

The unforseen is the law of combat, but the art of command is to improve your will upon the enemy.

However powerful the artillery and the skilfulness of the preparation of an asault may be, one must expect, in an attack, to come in contact with strong points or organizations at reverse slopes which have not been absolutely destroyed and which still have some means of defense.

In order to reduce these strong points, work with the power of fire and employ all means at your disposal by the use of modern weapons.

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The attack of a strong point consists of three phases:

First: the preparation.
Second: the attack.
Third: the mopping up.

Preparations are made by the R. G.; the attack by A. R.; the mopping up by the bombers; these operations will be reinforced by machine gun fire.

The efficacy of bombardment by R. G. depends upon the number of R. G. put into action and their judicious distribution in the area of manoeuvre of the battalion. 48 R. G. can easily be disposed of 24 from the conmpany which comes in contact with the strong point, 12 from each company on the right and left flank and 12 from the reinforcement company.

The idea is, not to put the 48 R. G. in one straight line so as to be able to maintain fire control. This would, of course give excellent barrage fire, but would not solve the problem.

It is necessary to divide these 48 R. G. in groups of 6 to 12 according to the ground. giving them an enveloping movement so as to direct their fire on the front and depth of the objective, thus obtaining concentrated fire. Generally three platoons of machine guns and 24 A. R. are available to reinforce with their fire the bombardment of the R. G.

The first result of their bombardment, arranged on time notices by the major will be to compel the enemy to remain under cover, but nothing can be done until our bombers have gained a footing in the stronghold so as to mop up.

It is the autoriflemen's duty to bring the bombers, so to say, at their working point, in covering their approach march by their fire. As soon as the autoriflemen have gained footing in the strong point the bombers will rush rapidly forward and proceed to mopp up according to the established plan.

(E) Replenishment of Munitions.

1. Armaments issued before the combat:

Each Rifle-grenadier: 10 V. B. grenades.

Each carrier: 10 V. B. grenades.

2. At the command post of the Battalion.

800 V. B. grenades.

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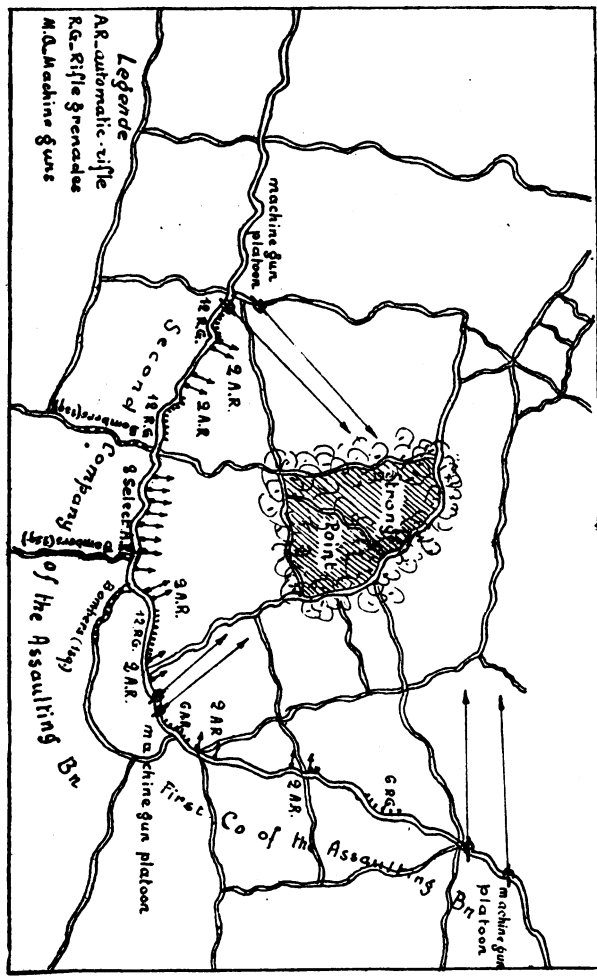
Legende
A.R._automatic-rifle
R.G._Rifle grenades
M.G._Machine guns
machine gun platoon
12 R.G.
2 A.R.
Second Company of the Assaulting Bn
Bombers (1st)
8 Select A.R.
Strong Point
9 A.R.
12 R.G.
2 A.R.
6 A.R.
2 A.R.
6 R.G.
machine gun platoon
First Co of the Assaulting Bn
machine gun platoon

Fig. 67.

3. Usual information for the establishment of a plan for replenishment:

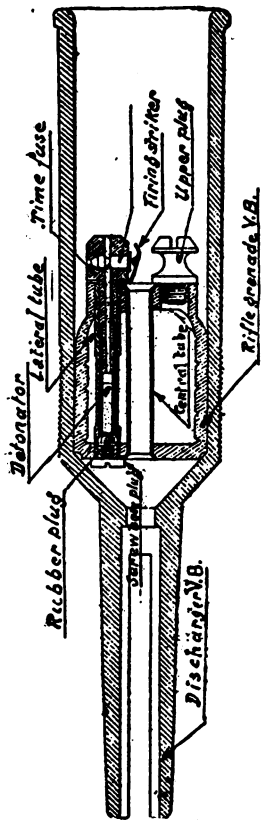

Fig. 67a.

(a) Replenishment by man power. One carrier is able to carry 40 V. B. grenades, weighing 42 pounds.

(b) Replenishment by mules.— A mule can carry 1 case of 100 grenades, V. B., 114 pounds, divided into 2 loads or bundles.

(c) Replenishment of a company. If one man carries 40 V. B. grenades in four sandbags (42 pounds), the replenishment of the company will be accomplished by four men making four trips. This replenishment is often useless, upon the occupation of the objective; few V. B. grenades are used even in the course of the attack if no strong point is encountered.

2. Technical Use.

I. Miscellaneous.—The rifle grenade is a part of all infantry equipment. Every man must be well drilled in its use. The number of dischargers issued is limited by their weight and the limitations of ammunition supply. The V. B. grenade has the advantage that it is not very cumbersome and that it is fired by means of the ordinary ball cartridge.

II. Description. (Fig. 67a).—The V. B. grenade is thrown with the aid of a discharger "tromblon," fitted on an infantry rifle, using service cartridges. This discharger is a cast piece of steel adjusted to the muzzle of the rifle. It has an opening permitting the space for the front sight. The grenade is a fuse typed steel

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body with interior grooves. It contains two tubes permanently held in place; a central one through which the bullet passes and a lateral one which receives the igniter time fuse and detonator. The time fuse carries a primer and a plunger.

The bullet strikes the plunger which lights the primer. The primer ignites the fuse and at the same time, the gases of the cartridge expand into the discharger "tromblon" and project the grenade. It will explode after 5 or 6 seconds.

III. Equipment and Lighting System.—The throwing is effected by means of an ordinary ball cartridge; the pressure of these gases gives a propelling force which incites the percussion by striking the plunger.

The primer starts fire to the column of powder in the lateral tube and at the expiration of 5 or 6 seconds, the detonator producing the explosion of the shell.

The security is assured by automatic lighting.

On the other hand, the function of the plunger demands a violent shock.

IV. Maneuvers.—Loading:

1. Insert the V. B. grenade as far as it will go, its base resting on the bottom of the discharger, bolt being open.
2. Load the rifle with a regulation ball cartridge.
3. Incline the rifle at a correct angle.
4. Fire.

Note:—Place the butt on a flexible support or on loose surface to diminish the violent recoil.

V.—Details.

1. **Transportation.**—The tromblons for the firing of V. B. are carried on the belt in a leather case, by the rifle grenadier. He also carries shells in a grenade basket, or in a grenade carrier belt, Model 1916.

2. Supplies are assured, by conditions foreseen by the bombers. Easy in the defensive. It will be necessary to foresee the difficulties in the offensive and give the rifle grenadier V. B. as many shells as possible.

One has to remember that only 50 per cent. of the supplies from the first line will be brought to conquered positions.

Wagons for transportation of grenades, telephone wires, etc., will be equally used for the transport of V. B. grenades.

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3. **Weight and Charge.**—The total weight of the grenade is 15 ounces; 2 ounces of which is cheddite explosive.

Length of Burning.—5 to 6 seconds.

The shells are delivered in cases of 100, ready for use.

VI. RANGE TABLE.

The range depends on the inclination of the rifle.

Angle	Range in Yards	Time of throwing in seconds	Explosions
45°	200 yds	5'' 2-10	Delay of 1'' 3-10
50°	195 "	5'' 6-10	" " 0'' 9-10
55°	185 "	6''	" " 1-2 9-10
60°	170 "	6'' 3-19	" " 2-10 9-10
65°	150 "	6'' 3-10	Explosion on surface
70°	125 "	6'' 8-10	" at 5m from surface
75°	100 "	7''	
80°	70 "	7'' 2-20	Explosion 5 to 12m from
88°	35 "	7'' 3-10	surface

These indications are but approximations, and the firing when possible, must be regulated from the first falling point.

The points correspond to the firing with a ball cartridge D, loaded with B N 3 F powder. The ball cartridge D loaded with American powder gives a range of about 1-16 shorter.

The gradual overheating of the rifle during shooting is accompanied by an increase of range (about 22 yards when the rifle is inclined at a 45 degree angle).

The interior of the discharger must be kept perfectly clean and slightly greased. All rust from the body of the grenade must be removed.

The shell can be fired without danger to the rifle grenadier, whether the rifle is at right shoulder or in the position of "guard," but accuracy is poor. Execute the firing preferably by using racks, or in the kneeling position, butt on the ground. See that racks are in good condition and solidly held by sand bags.

It must not be forgotten during shooting practices that cartridges attain a range of 4,400 yards, and that special

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precautions must be taken to have the access of rifle ranges sufficiently long enough to have a minimum range of 5,000 yards, so as to avoid accidents.

A blank cartridge loaded with B N 3 F powder can be used to fire a R. G. To obtain similar results as with the ordinary cartridge the plunger must be set at 45 degrees.

II. THE MANDREL D. R. AND ITS GRENADE.

(Fig 68 and 69).

This grenade differs from the V B on the following points:

It fits onto a "mandrel" instead of being put into a discharger. It has a percussion fuse. It is fired by a special blank cartridge, instead of an ordinary ball cartridge. It

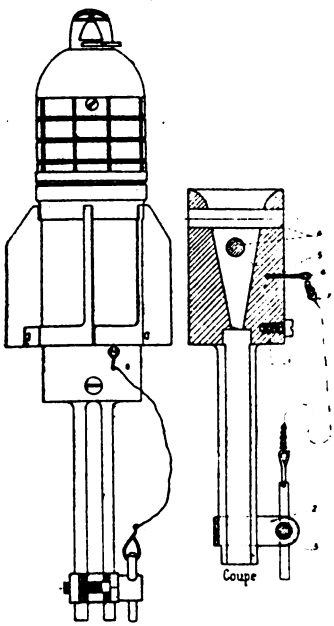

Fig. 68.

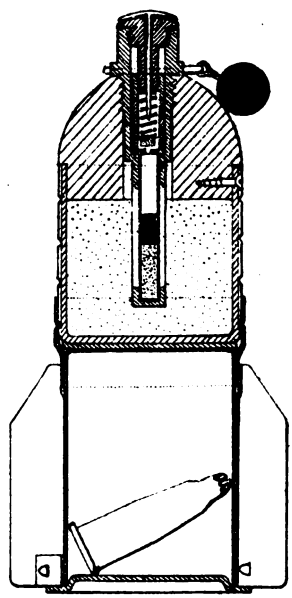

Fig. 69.

is more cumbersome ,but has twice the range and is more effective. It has a cast-iron body, elongated toward the front by a wooden ogive and a fuse and toward the rear by a swaged

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sheet-iron cylinder base with four vanes. This cylinder incloses the special cartridge, held in place by a pasteboard plug. Fire with the butt resting on the ground or in the position "charge bayonets," or from the special metal frame. The range is found by varying the angle at which the rifle is held, or, preferably, by maintaining an angle of 45° and regulating the volume of the expansion chamber. This is done by pushing the regulating pin into a hole corresponding with the desired distance. This pin controls the setting of the grenade on the mandrel.

Use.—Fix the mandrel on the rifle, regulate the angle and regulating pin; remove the pasteboard plug, extract the cartridge, and fix the grenade on the mandrel; remove the fuse safety pin; load the rifle with the special cartridge, and fire.

Details.—**Never fire with a ball cartridge.** Lubricate all contact surfaces. Straighten any vanes which may have been bent. Shipment to armies is made in cases of 24, ready to use. Weight of one grenade, 1 lb., 4 oz., 276 grains, including 3 oz. of explosive. Maximum range, about 490 yards, to be obtained by firing at an angle of 42°, with the grenade shoved all the way down.

This grenade is not used by U. S. A.

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CHAPTER II,

British Rifle Grenades

I. Hales Rifle Grenade, Short Rifle, No. 3, Mark I (Percussion). (Fig. 70).

The following type of grenades are now in use:

I. Description.—Serrated steel, filled with explosives. Down the center of the explosive is a brass tube into the forward end of which the detonator is inserted. The body is closed by the base piece. This carries the striker pellet, two retaining bolts, wind vane, releasing socket, and safety pin. To the base piece is fixed a base plug carrying the spring clip and a 10-inch steel rod.

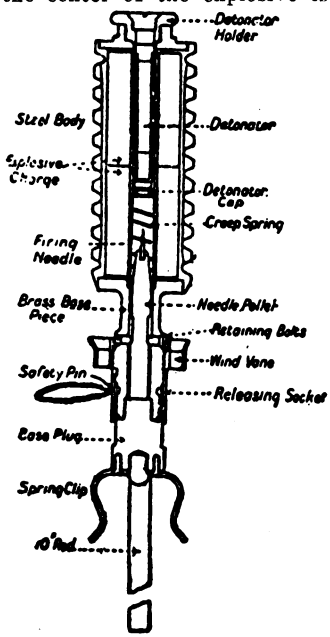

Fig. 70.

Detonator Holder.—Consists of a special brass tube which screws into the head of the grenade. It is 2½ inches long and contains a detonator and a detonator cap. Until the detonator is inserted the head of the grenade is closed by an ebonite screw plug.

Cartridge.—A special blank cartridge is supplied to fire the grenade.

Action.—The action of the grenade on being fired is as follows: The wind wave revolves as the grenade travels through the air; after a few turns of the vane the retaining bolts are no longer held in position by its inner surface and fall out; on impact the striker pellet sets forward against the creep spring onto the detonator cap, thus firing the grenade.

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This grenade is very safe to handle, as it cannot be fired by knocking or dropping on the ground; it must travel through the air some distance before the retaining bolts fall out.

Weight, 1 pound, 5 ounces.

Mean maximum range, 185 yards.

Instructions.

II. Use.—To prepare for use:

1. Holding the grenade head down so as to make certain that the needle is not free, remove the ebonite screw plug.

2. If correct, screw in the detonator holder.

To fire:

1. Lower the rod into the barrel of the rifle, and clip over the muzzle.

2. Load the rifle with the special blank cartridge.

3. Immediately before firing withdraw the safety pin.

If, after the safety pin has been removed, the grenade is not used, the safety pin may be replaced if the wind vane has not unscrewed and uncovered the two retaining bolts; but if these are uncovered the grenade is in a dangerously sensitive condition, and if so found should be destroyed.

III. Details.—Special precautions to be adopted when firing No. 3 rifle grenade (either with or without pin or wind vane).

1. The grenade should be tapped on the palm of the hand before inserting the detonator, to insure that the striker pellet is properly held in place by the retaining bolts.

2. The wind vane and the releasing socket must not be tampered with.

3. The safety pin must not be removed before the grenade has been inserted in the rifle.

4. The detonator holders of No. 2 and No. 3 grenades are of slightly different lengths, but otherwise very similar. Care should be taken not to mix them up. A No. 2 detonator holder in a No. 3 grenade would probably cause a blind; the correct detonator holders are supplied in the grenade box.

5. **The grenade must not be fired with a cartridge with a bullet in it (ball cartridge), as this may burst the rifle.**

6. The rod should be oiled, but only slightly, before placing it in the barrel of rifle.

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Inspection.—The following points should be noticed.

1. That the wind vane is covering the retaining bolts.

2. That the releasing socket and safety pin are correctly in place.

3. That the striker pellet is held correctly by the retaining bolts, which fit into a groove in it and should prevent it from moving.

4. That the creep spring is in position over the striker pellet.

5. That the screw thread and cavity for the detonator holder are clean and clear.

6. That the rod is straight and clean.

7. That the metal at the lower end of the detonator holder is correctly turned in over the detonator cap, so that the latter is securely held. If it is not, the cap may come out on the shock of discharge, strike the needle, and so cause a premature.

Packing.—The wooden box provided contains 12 grenades, 12 "detonators, rifle grenades" (which are detonator holders complete with detonators), and 12 special blank cartridges in a tin box.

2. **Vaneless Rifle Grenade, No. 20 (Fig. 71).**

I. Description.—This grenade is an improved form of No. 3 without the wind vane and spring clip. The safety pin is below the releasing collar.

Body.—Serrated steel filled with explosive. Down the center of the explosive is a brass tube, into the forward end of which the detonator is inserted. The body is closed by the base piece. This carries the striker pellet, two retaining bolts, releasing socket, and safey pin. To the piece is fixed a 10-inch steel rod.

Detonator holder.—Consists of a special brass tube which screws into the head of the grenade. It contains a detonator and detonator cap. Until the detonator holder is inserted the head of the grenade is closed by an ebonite screw plug.

Cartridge.—A special blank cartridge is supplied to fire the grenade.

Action.—On the shock of discharge, the releasing socket sets back; the retaining bolts are no longer in position by its

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inner surface, and fall out. On impact the striker pellet sets forward against the creep spring onto the detonator cap, thus firing the grenade.

Weight, 1 pound, 6 ounces.

Mean maximum range, 150 yards.

Instructions.

II. Use.—To prepare for use:

1. Holding the grenade head downward, remove the ebonite screw plug, and tap the grenade on the hand, so as to make certain that the striker is not free.

2. If correct, screw in the detonator holder.

To fire:

1. Lower the rod into the barrel of the rifle.

2. Load the rifle with the special cartridge.

3. Immediately before firing withdraw the safety pin. If the grenade is not fired the safety pin may be replaced.

III. Details.—Special precautions:

1. The grenade should be tapped on the palm of the hand before inserting the detonator holder, to insure the striker pellet is properly held in place by the retaining bolts.

2. The releasing socket must not be tampered with.

3. After withdrawing the safety pin it should be noticed that the releasing socket is still in its right position; it may slip back (thus releasing the retaining bolts) if it has not been properly secured over the retaining rim during manufacture. **A grenade in this condition is dangerous, and would probably explode prematurely at the muzzle.**

4. The safety pin must not be withdrawn before the grenade has been inserted in the rifle.

5. **The grenade must not be firod with a cartridge with a bullet in it (ball cartridge), as this may burst the rifle.**

6. The rod should be oiled, only slightly, before placing it in the barrel.

7. The detonator holders for grenades No. 2 and No. 20, are of slightly different lengths, but otherwise very similar.

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Care should be taken not to mix them up; a No. 2 detonator holder in a No. 20 grenade would probably lead to a blind. The correct detonator holders complete with detonators are supplied in the grenade box.

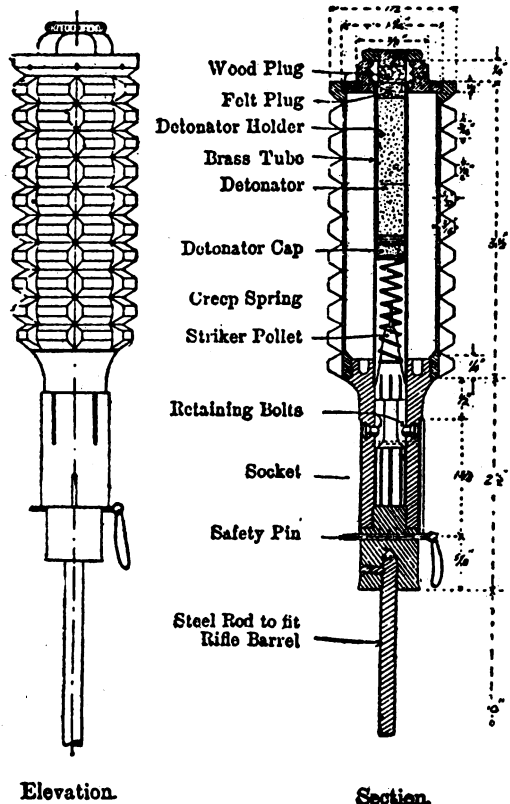

Fig. 71.

Inspection.—The following points should be noticed:

1. That the releasing socket and safety pin are correctly in place.

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2. That the striker pellet is correctly held by the retaining bolts, which fit into a groove in it and should prevent it from moving.

3. That the creep spring is in position over the striker pellet.

4. That the screw thread and cavity for the detonator are clean and clear.

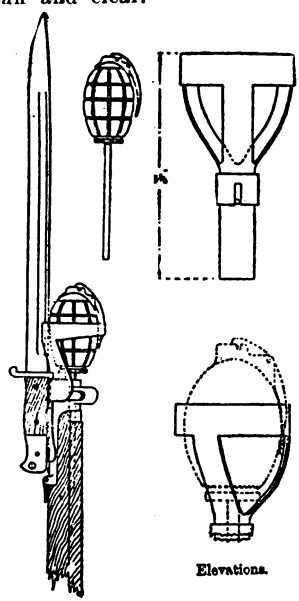

Fig. 72.

5. That the rod is straight and clean.

6. That the metal at the lower end of the detonator tube is correctly turned in over the detonator cap, so that the latter is securely held. If it is not, the cap may come out on the shock of dischage, strike the needle and so cause a premature.

Packing.—The wooden box provided contains 12 grenades, 12 detonator holders (containing detonators) in a tin box, and 12 special blank cartridges in a tin box.

3. Mills Rifle Grenade No. 23, Mark 1 (Fig. 72).

I. Description.—This is a No. 5 (Mills) grenade with a short rod, 5½-6 inches long, screwed into the base plug of the grenade. The hole in the base plug is filled with wax or luting when issued, in order to keep the grenade damp-proof in case the rod is not required.

Cartridge.—A special blank cartridge is supplied to fire the grenade.

Ring Attachment.—In order to keep the lever of the grenade in place after the safety pin has been removed previous to firing, a ring attachment is fixed to the rifle by means of the

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bayonet; it is so constructed that it can be used either with the long or short bayonet.

This attachment can not be used with the long rifle (owing to the lack of space between the bayonet and the bore of the rifle). A special attachment is necessary in this case to take the place of the bayonet.

Action.—When the grenade is shot out of the rifle the lever is no longer held down by the ring attachment and the normal (Mills) grenade action follows.

With a 5½ inche rod the maximum range is 80 yards with the rifle at an elevation of 45°

Variation of range is obtained by altering the elevation of the rifle. The rifle may be fired from the shoulder or hip, as there is very little recoil.

The grenade without the rod can be used as a hand grenade.

Weight, 1 pound, 9 ounces.

Mean average range, (with 6 inch rod) 90 yards.

II. Use.—To prepare for use:

.1 Unscrew the base plug and insert the igniter.

2. Screw in the base plug with the key provided, taking care that it is screwed home.

3. When required as a rifle grenade, screw in the short rod.

To fire:

1. Fix the ring attachment to the bayonet.

2. Fix the bayonet.

3. Lower the rod into the rifle until the grenade is within the ring attachment and the lever is held by the ring.

4. Load the rifle with the special cartridge.

5. Immediately before firing, withdraw the safety pin.

III. Details.—Special precautions:

1. When inserting the igniter see that the fuse is not cracked or damaged, as this may accelerate time of burning.

2. The lever must be held securely by the ring against the body of the grenade.

3. The safey pin must not be withdrawn before the grenade is inserted in the ring attachment.

4. The cartridge must not be fired with a cartridge with a bullet in it (ball cartridge), as this may burst the rifle.

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5. The rod should be oiled, but only slightly, before placing it in the barrel.

6. The rod must be firmly screwed in.

Inspection.—In addition to the points noticed under No. 5 (Mills) grenade:

1. Only grenades with solid base plugs should be used for rifle grenades, as otherwise the rod is liable to break the plug and cause a premature.

2. The hole in the base plug should be filled with wax or luting.

Packing.—The wooden box provided contains 12 grenades, 12 igniter sets, 12 rods, and 12 cartridges.

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CHAPTER III.

German Rifle Grenades

1. **Their use, as shown in the German book of rules.—**

Rifle grenades are used for close fighting for the defensive as well as for the attack. Gathering of troops, detachments of workers in sap heads, columns of assault, material prepared for an assault, constitute excellent targets. It is advisable when a trench is taken under fire, to make a barrage fire with rifles so as to prevent the enemy's escape. It would be advantageous to the infantry to fire from different places situated at large intervals so as to puzzle the enemy about the positions from where the shells are fired.

The best way to use mortars is to use flank fire, to destroy dead angles and to cause continued fires in large zones, etc.

II. Nomenclature.

The following type of grenades are now in use:

1. **Rifle Grenade, Model 1913, (Percussion). (Fig. 73).**

1. **Description.**—Steel, 4.3 inches long and 0.16 inch thick, is serrated longitudinally and transversely, so that on detonation it may split up into fragments of sufficient size. It is painted gray. The base is closed by a brass base cup, which has screwed into it a steel tail rod 18 inches long, with copper gas check to take the grooves of the rifling. The rod has a thin coating of copper to protect it from rust and also to protect the barrel. A thin disk is fastened to the head of grenade by the igniter plug for short ranges.

Method of ignition.—An igniter plug, carrving cap and detonator, screwed into the head of the grenade. A brass tube passing through the center of the grenade contains a striker pellet, with needle and creep spring.

Safety arrangements:

1. A powder safety device is contained in base cup. Screwed into the striker pellet is a spindle which passes through into

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the base cup and has at its lower end a small platform with three flash holes. On this rests a pellet of compressed powder, the object of which is to keep the striker moving forward until a short time after the grenade has left the rifle. This powder is ignited by means of a small brass pellet with a cap, which sets back on the shock of discharge, and, flattening a small spring, is penetrated by a needle on the screw plug closing the base cup. A vent hole in the base cup allows the escape of the gases of combustion. This is normally sealed with wax.

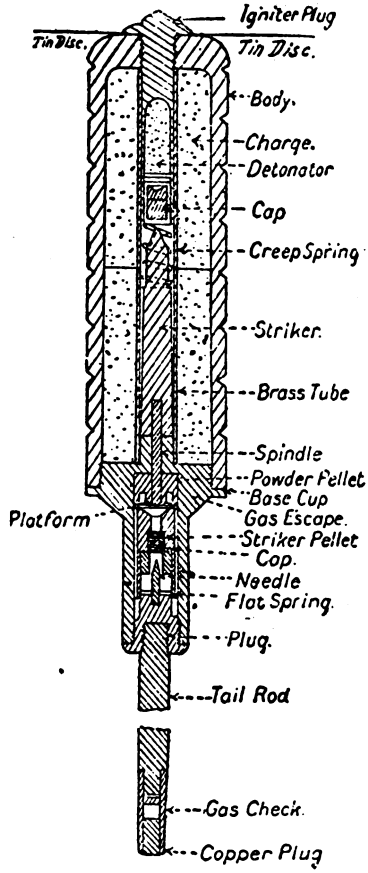

Fig. 73.

2. When the powder is burned away the striker is only prevented from moving forward by a creep spring, the resistance of which is overcome on strike.

II. Use.—To use:

1. Unscrew zinc plug from head.

2. Screw in the igniter plug (with tin disk for ranges under 200 yards).

3. Lower the grenade carefully into the barrel.

4. Insert a rifle grenade cartridge in the breech.

5. Fix the rifle at the required elevation.

6. Fire the rifle.

To render useless: Unscrew the igniter plug in the head of the grenade, holding the grenade with the rod downward.

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III. Details.—Precautions:

1. A German rifle 98 or 88.05 only can be used.

2. Care must be taken that the grenade is not dropped, especially on the tail rod, as then it is liable to become "live," and will therefore detonate on firing. It shauld be carried head uppermost by the grenade, not by the rod.

3. The special rifle grenade cartridge must be used, and in no case a ball cartridge.

4. Tail rods which jam or rub when being placed in the barrel must not be used, and no force is to be employed.

5. Damp tail rods must be dried before use. All rods should be firmly screwed in.

6. Weight, about 2 pounds, 3.2 ounces of explosives.

7. Maximum mean range, 350 yards.

RIFLE GRENADE, MODEL 1914, (PERCUSSION). (Gewehrgranate).

I. Description.—Cast iron, 0.2 inch thick, painted field gray and serrated to give fragments of sufficient size on detonation. The charge (2¾ ounces) is made up in a thin cardboard cylinder, which is retained in the grenade by a shoulder piece screwing on to the body. The nose of the grenade is screw-threaded to take the percussion fuse, and the base to take a nipple for a tin disk and tail rod with gas check. Until the fuse is inserted the nose is protected from dust and damp by a plug and leather washer.

Method of Ignition.—The percussion fuse contains an exploding charge with detonator and cap. The last-named is set off by a striker pellet screwed into the socket of the fuse. The needle of the pellet is hinged and lies flat on top of the cap when in the safety position, but is pullel and maintained erect by the spring in the striker pellet as soon as the pellet moves forward after firing.

Safety arrangements:

1. The striker pellet is retained in position by a locking ball, which rests in a recess in the pellet. This ball is prevented from falling out by a locking ring which is held up by a flat spring with curved ends. On the rifle being fired the locking ring overcomes the spring and sets back, and the locking ball is driven out of its recess by the striker pellet, which,

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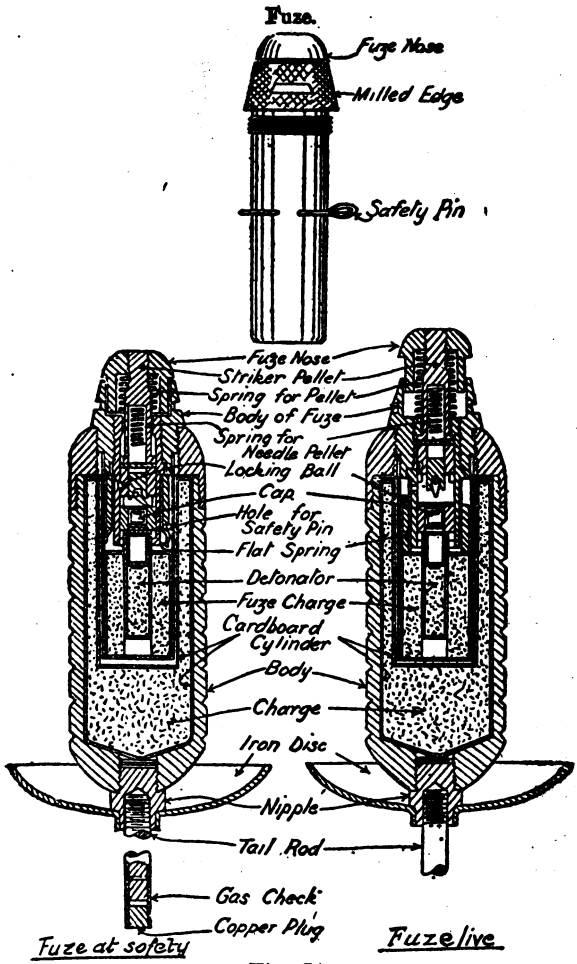

Fig. 74.

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acting under the pressure of its spring, moves forward out of the body together with the nose of the fuse. At the same time the needle pellet spring pulls up the needle into the firing position.

2. The striker pellet is prevented by its spring from being driven back onto the cap until impact.

II. Use:

1. Unscrew plug by means of the key, pull the two-pronged safety pin from the fuse, and screw the fuse in slowly and carefully by means of the key .

2. Lower the grenade carefully into the barrel.

3. Insert special cartridge in the breech.

4. Fix the rifle at the required elevation.

5. Fire the rifle.

To render useless: Unscrew fuse from the grenade.

III. Details—

1. A German rifle, 98 or 88.05 only can be used.

2. Care must be taken that the grenade is not dropped, especially on the ail rod, as then it is liable to become "live," and will therefore detonate on firing. It should be carried head uppermost by the grenade, not by the rod.

3. The special rifle grenade cartridge must be used, and in no case a ball cartridge.

4. Tail rods which jam or rub when being placed in the barrel must not be used, and no force is to be employed.

5. Damp tail rods should be dried before use. All rods should be firmly screwed in.

Warning: Grenades with live fuses should not be fired or touched. They are easily recognizable, as the nose of the fuse will be found sticking out (compare figs. left and right). Grenades in this condition should be destroyed as soon as possible.

6. Weight, about 2 pounds.

7. Maximum mean range: 380 yards.

General Remarks.—Non-exploded grenades must not be picked up; they must be destroyed immediately.

3. NEW GERMAN RIFLE GRENADES.

A rifle grenade similar to the French Grenade is now in process of manufacture; and will soon be used at the front.

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As per information gathered from a deserter, asphyxiating grenades were issued to his regiment, and are 3 times as large as the oval shaped grenade, at the same time very light and also containing tear producing gases.

GERMAN SMALL THROWING MORTARS.

1. The Germans were the first to use trench mortars for throwing all kinds of grenades at long distances. The power of projection being obtained by the tension of a spring:

The Grell mortar had a range of 90 yards.

The Simon mortar had a range of 300 yards.

Later the Germans constructed small mortars, manned by crews of infantrymen. The propulsion is obtained either by tension of a spring, compressed air or gas pressure from the deflagration of a charge of powder.

3. Large and mine throwing engines are called "minneuwerfer."

4. "Medium strength" mortars are used like the minnenwerfer, to complete destruction begun by the Artillery.

There are two models (1915 and 1916). Both (Granatenwerfer) mortars throw the same grenade (model 1915) (Tourterelle), and a third one that has just been put into use.

Model 1916 deserves special mention and description.

(A) GRENADE THROWER, MODEL 1916 (GRANATENWERFER M. 1916) (Fig. 75).

Throwing the Grenade, Model 1915 called "Tourterelle." (Fig. 76).

The "Granatenwerfer" or "grenade throwers" used by the Germans, in trench warfare, as trench mortars; but their perfect mobility enables them to use these in open warfare.

Our enemies have two models: 1915 model and 1916; the latter is much lighter and easier to handle. Both fire a serrated grenade, having at its head a long instantaneous percussion fuse, and at its base, a tube with three tiny wing-shaped projections.

They throw a smokeless powder grenade.

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The grenade thrower, Model 1916, complete, weight but 80 lbs.

48 pounds for the apparatus thrower.

32 pounds for the platform.

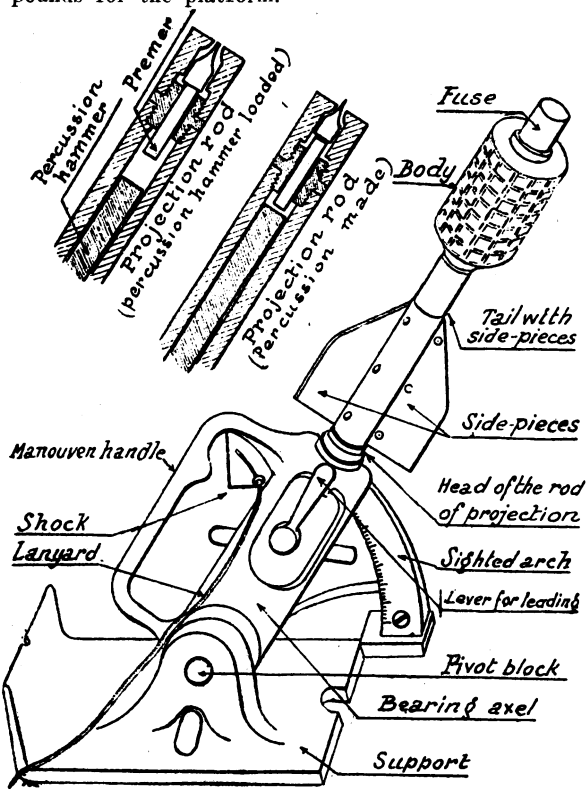

Fig. 75.

From whence easy changes of positions are possible, the shelter of the mortar, when the position of the piece is definitely located. The grenade thrower is carried around with the use of only one hand.

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1. **Description.**—(Fig. 75). The mortar is composed of:

The throwing apparatus.

The platform.

The apparatus for throwing comprises:

The projection rod.

The **pivot block with securing parts.**

The **frame with graduated (sighted) arch and an aiming notch.**

The platform consists of:

A **baord** with recoil checking axle spade at the head.

A **tappet disk with a watch front,** knurled, on a pivot on the front end of the board.

In the projection rod the following.

The placing of an immovable point of the striker.

The canal of the rod from the percussion hammer.

In lowering the lever of the apparatus, a ramp brings the percussion hammer backwards.

The mechanism is **at the loading** and at **the safety lever.** When the lever is brought back, the safety pin is affected and the mechanism is cocked.

To release the percussion hammer, take care to:

1. To take shelter (very important to stay under cover, as splinters from the cartridge sleeve rebound as far as 10 yards.

2. Work the trigger by means of the lanyard. The release is made as soon as rocking takes place, independent of the sway of the spring.

After firing the head of an indicator rod will show slightly, projecting from the cylinder pin. The appearance of this indicates that the mechanism is unloaded.

II. Projectile. (Fig. 76).—The grenade model called "Tourterelle) is composed of a grenade body (1) of malliable cast-iron with a grasping rail (7) at the head of which is a compartment (5) for throwing cartridge (6).

The percussion fuse consists of:

A fuse case (8), which has a compartment at the bottom (3) for a **detonator** (4) above and over this detonator a relay wax plug (13) in a sliding plunger sleeve, **carrying a striker** (9) away from the **primer** (11) by the aid of a **spring** (10). A screwed plug (16) protects the primer.

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A safety pin (15) prevents all premature percussion .

The projecting cartridge (6) resembles that of the infantry rifle model 1898 (bullet extracted), holding 3 grains, 2 of powder.

III. Equipment and Percussion.—During transportation, the grenade has a fuse attacked, but the detonator is not in its compartment (3). The priming is done only by order and when an attack is expected.

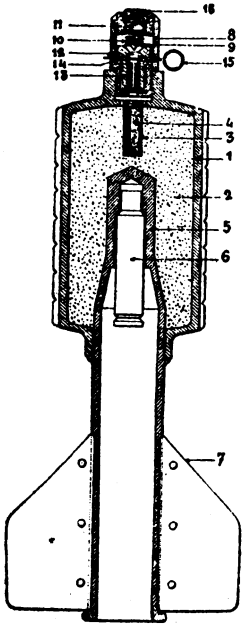

Fig. 76

The bolt pin is taken off only when the grenade is placed on the projection rod.

The explosive is a type of ammonia nitrate and tolite.

For throwing, the grenade is placed on the projection rod, cased in the grasping tail, the end of the rod directly in contact with the head of the cartridge.

When firing, (see above) the percussion hammer, freed, strikes the firing pin which strikes the cartridge cap the powder is lit and the gas without emitting on the side of the rod, pushes the grenade which is thrown out of the rod in a prolongation of the same direction.

IV. Maneuvers of the Mortar.

Consists of the following operations:

(a) **Installing the platform.** On the ground, the end of the plank in the ground, handle in front, level and horizontal; platform must be immovable during the firing.

(b) **Place apparatus for throwing.**—Place on platform in order that the front end is exactly inserted into the buffet-disk. The clamp of this disk is in the hollow of the frame.

(c) **Aiming at a target.**—Turn apparatus on a pivot the same time as the tappet disk so as to aim directly at the target.

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(d) **To aim high.**—Give angle of fire.
(e) Load, and place on "Safety."
(f) Pass lanyard clasp through peephole of the trigger.
(g) Place grenade, already primed, on projection rod.
(h) Detach safety pin from fuse.
(k) Lower safety notch.
(i) Take shelter.
(m) Pull the trigger with the lanyard.

V. Distance and precision in firing.—The maximum distance is from 300 to 450 yards.

The minimum distance is from 50 to 85 yards.

Range schedules apply to 2 kinds of firing:

The **curved firing**, which extends from 50 yards to 300 yards.

Fire giving a flat trajectory, 150 yards to 300 yards.

As regards width of flight in which all shots go:

Radius of 3 to 5 yards.

Distance of 50 yards.

VI. Tactical Use.—The "granatenwerfers" are installed in small saps behind the first line; fired from an uncovered position, and can look for protection against fire from enemy artillery, only by changing places. They are separated from each other a distance of 20 yards.

During an attack, the "grantenwerfers" are brought to the front with machine guns and light "minenwerfers." They are attached to the second assault crew.

In 1916, each German regimental troop had two of these mortars.

(B) NEW GERMAN GRENADE THROWER.

As per information received from the British Army, a new grenade thrower, (Granatschnelleverfer), "rapid fire grenade throwers," has been recently put into use by "Fritz."

A smooth bored gun loaded from the breech.

Caliber: 39mm.

Range: Minimum, 650 yards.

Loaded from the breech by means of a 6 shot automatic loader, easily manipulated with the hands.

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Projectile: Cylindric shaped lead cartridge, 114 mm. long and 39 mm in diameter, to which is screwed an iron pointed contrivance, containing a fuse.

Weight of projectile, 800 grammes.

Weight of explosive, 40 grammes.

Simple (non-complicated) time fuse, probably operating by inertia, at the time of firing.

Use: To harrass workers.

Fire is affected in series of from 3 to 6 rapid shots. Noise compares to that of a machine gun, yet somewhat louder.

Projectiles burst either in mid-air or upon striking the ground; splintering and breaking into a large number of fragments.

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APPENDIX.

Appendix I. Precautions in regard to unexploded grenades.

Appendix II.—Illustrations of raids.

Appendix III.—Rules concerning the execution of tests for appointment as Bombers.

Appendix IV.—Explosives and Fireworks.

Appendix V.—"Firing Map" or "Battle Map" Sector of Champaign.

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APPENDIX I.

PRECAUTIONS TO BE OBSERVED IN REGARD TO UNEXPLODED GRENADES.

After each miss fire (grenades not having been exploded), it is necessary to pick up grenades.

Two distinctive cases: When fuse or primer grenades are used:

In the former case (fuse grenade) 10 minutes from the time of throwing must expire before going to the firing range to pick up non-exploded grenades. At the end of this time, the non-exploded fuse grenade can be considered harmless, and can then be picked up and buried. The the end of the exercise, 2 cartridges containing 135 grammes of cheddite solidly mite solidly tied together with a Bickford fuse, will be placed over the pile, in immediate contact with the grenades and a few shovels of dirt will cover the whole so as to assure a lound detonation. This done, all the personnel sheltered, an officer will light the fuse and take shelter.

In the latter case, (percussion grenades) it is imprudent to shake these non-exploded grenades, they must be destroyed one by one.

A cheddite cartridge, primed as above, in immediate contact with each grenade, and the whole should be covered with a little dirt cautiously thrown on the pile and not jammed.

The lighting of the fuse is the same as above.

In case of a detonation failing, allow 10 minutes before attempting to resume operations.

IT IS STRICTLY FORBIDDEN TO TAKE THE PRIMER OFF THE NON-EXPLODED GRENADE, BY UNSCREWING THE FUSE.

Concerning 1916 automatic lighting grenades, the failure of lighting is caused by the fuse on detonation not being lit or sometimes an error in its mounting caused by absence of primers and seldom by the non-function of the primers.

When percussion bolt canal is not plugged up with dirt, it is very easy to see if the primers are in working order, because the canal is then blackened. In this case, the grenade is not any more dangerous to handle than an ordinary grenade.

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If, on the contrary, the walls and bottom of the canal have a white or shiny aspect, it is due to the fact that the primers have not worked, and if so the percussion spring being in contact with the primer care must be taken that a shock does not ignite the grenades. In fact, when a dummy grenade is violently thrown against a hard object, and the primer has failed to light, the plug is destroyed, without obtaining any result from the percussion of the primer; thus is explained the weakness of the primer plug.

Whatever the case may be, when not sure that the primers have been ignited, it is prudent to keep watching them, in case they should be ignited by the shock in transportation, they can be thrown away.

It is strictly forbidden to unscrew the lighting plug of a loaded grenade, without having special apparatus which will protect the operator in case of explosion.

And as far as unknown Mortars are concerned, be especially cautious about taking off the primers of these non-exploded Grenades and unscrewing the fuse.

American Ignition Plug.—Grenades loaded with American ignition plug its verification is easy. First see that releasing lever has circled the lever bolt; then see that the striker has been tripped by the spring bolt.

In the first case the grenade can be picked up and rethrown.

In the latter case if the primer plug has worked the metallic parts of the striker and locking lug are blackened. If the primer plug has failed to work the metallic parts are shiny.

In both cases it is wiser to destroy the grenade.

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APPENDIX II.

ILLUSTRATIONS OF A RAID.

ILLUSTRATION I.

Raid Executed by Units of the 2nd Canadian Brigade. (Night of November 16-17, 1915). (Fig. 77 & 78).

The operation executed on the night of the 16-17 of November by the 2nd Canadian Brigade (5th and 7th Battalions) was made with so great a success that useful lessons can be derived from it.

Fig. 77.

1st, the moral superiority of the assailants, thanks to the fact that all necessary preparations necessary were made before the enemy, who dared not move.

Secondly, the perfection of these preparations barring none were made in such a way that nothing was overlooked.

Marshal Joffre, in his instructions to his officers, had ordered that all means must be used in order to make the life of the Germans a burden to themselves.

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THE OBJECT OF THE OPERATION was to act upon the moral of the enemy, to take prisoners and to inflict losses upon them by forcing them to bring reserves under fire of the enemy.

CHOICE OF THE POINTS OF ATTACKS.—Two simultaneous attacks were ordered:

(a) The approach march could be effected on the right bank of the River Douve.

(b) The objective of the attack could not be taken by the enemy by enfilade fire, yet this objective could be easily reached by projectiles from trench mortars from the British lines.

(c) There were three roads of access in case of a retreat, and all in sight;

(d) The objective of attack had already been violently bombarded several times without attempting to follow the bombardment by attack.

(e) More so, it was protected by a brush of thick heavy wire and by the Douve River, thought by the enemy to be a well protected stronghold.

The point of attack on the right was chosen for the following reasons.

(a) Approach march was invisible.

(b) Particularly strong point of the enemy's line;

(c) The distance which separated it made the enemy think that is was to be an attack on a wide front.

GENERAL REMARKS.—The patrols and scouts of the 2nd Canadian Brigade* had been so active that the enemy had to give up these posts and send out patrols. Not long before the day of the attack, Canadian scouts had cut all German wire entanglements, thus having a clear road to the German trench and had even reached the parapets. They carefully patrolled the whole terrain between the lines.

PREPARATION FOR THE ATTACK.—The attack decided upon, officers and the best men were chosen for its execution.

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*In the British Army, the infantry brigade is composed of 4 battalions. Each battalion has four companies. Each battalion has a platoon of grenadiers divided into 4 squads of 8 grenadiers each, and a reserve of at least 32 auxiliary grenadiers.

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These, all volunteers, were picked out of the same company, in order to maintain co-ordination. They were stationed in a ruined farm, for a week, located at the rear of the first line trench. They were provided with all possible comfort, especially with heat. In an adjoining field a fac-simile of the objective for the attack was built. The exercise was repeated several times, not omitting the retreat, and day and night officers and men accompanied the patrols and scouts out to the field so as to be perfectly familiar with the terrain. The crossings of ditches, bridges to ford the Douve were built and tested, grenades were placed in sand bags, 20 in each.

The men were trained to cross and climb over the barbed wires, chicken wire being placed over the other. Not only heated quarters were useful after the operation, socks and change of clothing was kept in readiness.

All these preparations being made, and each one knowing what his duties were, everything worked like a clock.

ORGANIZATION OF THE ATTACK.—

(a) 4 scouts to cut the wire.

(b) I officer and 13 men to attack and to block the trench on the left flank.

(c) 1 officer and 12 men having same mission to attack on right flank.

(d) Detachment of 3 men to guard two bridges each supplied with rifles.

(e) Detachment of "rifle-men" for attack of the trench. One officer and five men, plus two telephone operators with apparatus and two litter carriers.

(f) Support detachment for listening posts, non-commissioned officer, 18 men, two telephone operators with apparatus.

(g) With reserve detachment, who stayed at first trench, two non-commissioned officers and twenty men.

Attack on the right was organized on the same basis.

PRECAUTIONS TAKEN FOR THE ATTACK.—Suppression of all marks and articles permitting identification.

(b) All officers and men who took part in the attack put masks on, with a black veil so that their faces would not be seen at night and at same time being a mark of distinction and to recognize each other.

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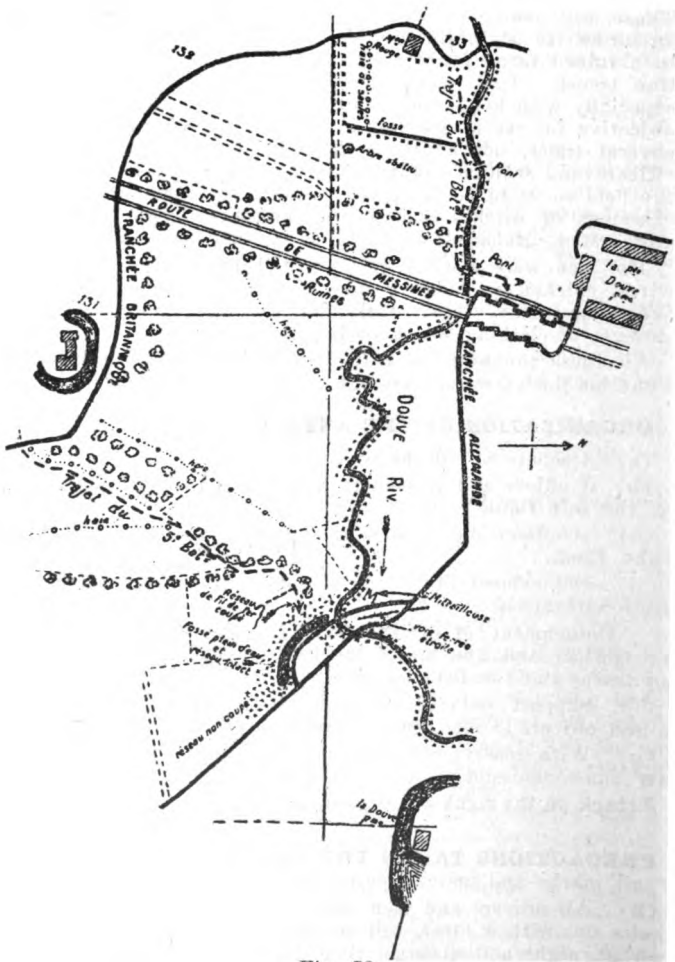

Fig. 78.

Sketch of the ground and position where raid was made.

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(c) Flashlights had been purchased in the country and were fixed on the barrel of the rifle of the men armed with bayonets. This would blind the enemy and permit the riflemen to see inside the shelters.

(d) Wire entanglements were already prepared and brought to block the trenches; revolvers and shears were distributed to the men who might have use for them.

(e) Trench marks were made in advance on different roads and near grenade stores.

Climatic Conditions—The attack was at first set for the evening of the 15-16 November, but was postponed until the next evening on account of the high tide of the Douve. Midnight was the designated hour for the attack as it is an hour seldom for attacks, but which offers every advantage in case of being repulsed, to have time before sunrise to escape under cover of darkness.

But a full moon, and the white frost causing fallen limbs to crack under their footsteps, would have notified the enemy of an approach. The hour of the attack was marked for two thirty, half hour after moon down.

Preparation and Support by Fire.—On November 16 at 9:00 o'clock in the morning, the barbed wires were bombarded, not only in front of the objectives of the attack, but also on other points.

A battery of trench mortars bombarded the "Petite Douve" farm and sheltered machine guns in the evening and by intervals at night.

These same objectives had been a target for machine gun fire, also for certain points in the rear, the latter during preparations for the attack. During the day and at night the "snipers" rifle batteries and rifle grenadier throwers showed great activity. During the night a slow fire was kept on, to stop them from hearing the patrols around the starting points of the attack.

During the attack, the artillery made a barrage fire behind the German trenches and bombarded all roads, trails and approach trenches from whence reinforcements might come. The trench mortar battery violently bombarded the "Petite Douve" farm and at the same time, an intense fire by machine guns, rifle batteries, and rifle-grenade throwers was released from the Canadian line.

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Work of the Scouts.—When the artillery fire had finished cutting the wires, that is at 4 o'clock in the evening, the scouts came out to see what had been done.

In front of the attacking point on the right the barbed wire had been destroyed. In front of the attacking point on the left it was almost intact, a row of trees having checked the fire. So it was decided that the wires be cut by hand. At night, four scouts started out to do the work, but only while the moon was hidden. It took them three hours to break through a line, cutting entanglements unseen by the enemy.

These four men were given hot cocoa three times and were given new gloves during the operation.

Likewise for the scouts who put up the bridges, they were also given cocoa. Their work was very delicate and lasted until two o'clock in the morning.

One of these bridges (pontoons) was 15 yards from the enemy's parapets.

Grenade depots extended over the whole front.

Execution of the Attack from the Left. (7th Battalion)—British Columbia's 7th Battalion had been trusted for this side, and when a violent and sudden shower of enemy shot fell they began their attack. The column followed the right bank of the Douve, and directed by scouts, crossed the pontoon that had been prepared by the former.

An enemy sentinel sheltered from a pouring rain, was shot by one of the officers, and the two detachments of bombers prepared to attack both sides of the trench simultaneously. The shelters were about full. One of the squads started to take some as prisoners (12), and killed the rest with their bayonets or by throwing grenades into the shelters. However, the extremities of the trench were solidly blocked, and telephone communciations had been established with the starting trenches.

The entire operation was performed without the least difficulty. At 2:28 o'clock a barrier fire started, at 2:32 the enemy trenches were penetrated, and at 2:34 they phoned headquarters saying "All's well."

A light grenade counter attack was attempted but was easily repulsed. At 2:52 or 20 minutes later signal for departure was given by the blast of a whistle. The prisoners had been sent in back at the beginning.

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Unfortunately, on their way back a man tripped, his rifle fell and killed the man in front of him. He was relieved of his equipment and everything which would give information to the enemy.

Outside of this unfortunate incident, only one man was slightly wounded.

Two of the bridges were destroyed by the scouts as soon as the detachment came back on the other side of the river; the third was taken down the following day. All grenades which were not used were taken back. The men, upon returning, changed clothes and warmed up.

Attack from the Right. (5th Battalion).—The scouts had found out that the barbed wire had been cut 20 yards on the front; but in the rear a ditch filled with water and covered with barbed wire entanglements remained untouched. The first five men fell in the ditch and were only taken out with difficulty. This attracted the Germans attention and they opened fire, but a volley of grenades soon silenced them.

While the men were being taken out of the water, and from the wires, which took some time ,the scouts looked for another passage to reach the enemy trench. Not being able to find one, the detachment returned quietly without the least loss.

When the two detachments got back to their trenches, the Canadian artillery shortened their range and bombarded the German trenches which had first been attacked.

Reaction of the Enemies.—For three quarters of an hour it was quiet, except the little counter-attack mentioned above. At the end of that time a counter attack began on both sides of the trench that had been taken, evidently executed by the remaining personel at an immediate vicinity. The enemy fire pointed directly on the Messines road and his artillery barrage came on very slowly.

They must have thought that the line was pierced, because the "Petite Douve" farm was evecuated, and the second line began a heavy machine gun fire.

Inflicted Losses.—Besides 12 prisoners, the enemy had 30 or 50 men killed. The artillery fire must have caused more serious losses. This attack was an absolute surprise to the enemy.

Cause of Success:

1. Superiority of moral of such an extent, that the enemy did not dare, and later could not account for the preparation

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of the attack, not a listening post remained, and for more than a month they were forced to reply to requests made by the Canadians, and the scouts found great sport in insulting "Fritz" in every possible way.

2. The care in which each detail was studied and foreseen and prepared in such a way that nothing was left undone for the successful execution of the operation.

3. Good artillery co-operation as well as other means of attack. How did the 2 Canadian Brigades acquire that superiority of moral which permitted them to operate so successfully and what was the real cause of their success. When the 28th Division was relieved on a section of the front, the enemy were audacious and sometimes made hazardous raids up to the English trenches. At first a line of observation posts was established at a short distance from the trenches, then listening posts put farther up, and the scouts first, then the men gradually worked close in on the enemy trenches, the German observation posts were pushed back of their barbed wire entanglements, they were forced to retreat lest they be killed or taken prisoners. To attain these required three months time At the end of which time the territory separating the two lines belonged to the Canadians.

They knew every detail, as well as knowing the various moves made by the Germans and a knowledge of the layout of their trenches and where they were sheltered both day and night. So well did they know the terrain that they could go to various spots eyes bandaged and with gas masks on, and the Germans did not dare respond but by weak firing.

ILLUSTRATION II.

Raid executed by a small unit of the 2nd Zouaves. (August, 1915. Tracy le Va'). (Fig. 79).

Mission:

To capture an enemy's listening post. Take back the prisoners.

Effective:

One officer commanding the raid, 2 sergeants 1 bombing squad, 2 squads of infantrymen of 8 men each. 3 sappers equipped with shears, one per group. Barrage by a battery of 75s'.

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Ammuition and Equipment.—Every man of the grenade squad is armed with an automatic pistol, a trench knife and 15 grenades. The two squads of infantrymen are armed with rifle and bayonet, and each have 5 grenades.. Same equipment. Sappers equipped with shears and automatic pistol.

Site of L. P. (listening post) Details.—The space between the enemies' firing trenches is about 400 yards. The listening post is at 150 yards in front of the enemy trench. It is placed at the outlet of a sap covered from "A" to "B" in front of a hedge "m," at the bottom of a valley, and surrounded by wire entanglements. Behind the hedge, camouflage ground made with branches discloses a trench probably occupied by a small garrison, placed there, as a support to the listening post. The commander of the raid has studied with the commanding officer of the battery of artillery the position of this listening post. By the aid of photos, the situation of the listener's post had been exactly marked out, which is difficultly seen on one point of sector and trench element from "A" to "B" where the firing from the barrage is effected. The machine guns are M-1 and M-2.

The plan of the attack has been studied with the battalion leader. Preparatory exercises had been made in rear of the second line of trenches on an appropriate field.

Distribution of Duties.—The officer gives each squad its mission. We will start at 3:45 A. M. from listening post, in front, and at 80 yards from the French line.

1. Squad on the left will leave at 3:45 A. M. under the command of sergeant "N." Their mission is to cover the L. P. on the left side and bring assistance if needed to the squad on the right.

2. Squad on the right will leave at 3:45 A. M. under the command of a sergeant "P". Their mission is to march straight to the hedge and attack the part of the trench where the support garrison L. P. is hidden.

3. The Central grenadier's squad will start at 3:50 A. M. under the command of a lieutenant "G." It will march in straight column to the listening post.

4. 3:35 A. M. Two detonations are sounded. They are the two aiming shost of the 75. They burst right in the enemies' trench Z and Z1. The liaison N. C. O. of the artillery has to telephone exact range.

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5. 3:45 A. M.—Barrage firing begins; the left and right march in single file, keeping low and under cover. The wire netting is mowed down.

The bombing squad leaves, officer in the lead, in single file.

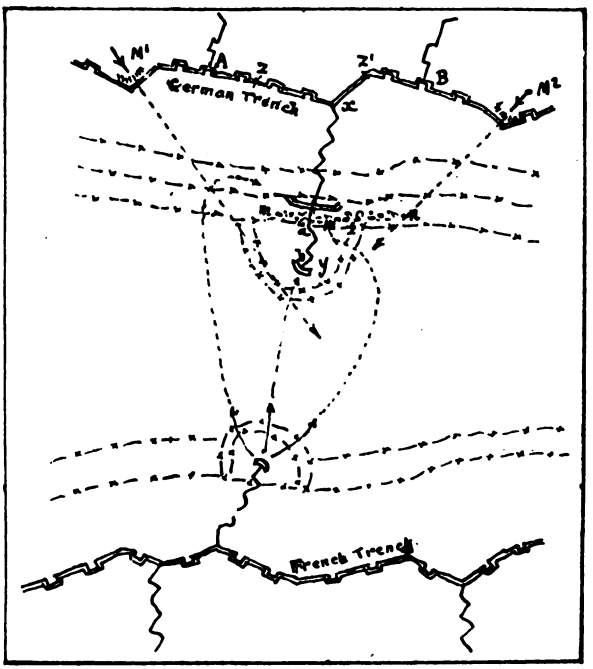

Fig 79.

6. 250 yards from L. P. flares are seen to come from the enemy trench. The three squads lay flat on the ground. By this light they notice the wires.

The darkness falls again—double time. The first hedge is The sapper being cutting, a skirmish ensues.. They pass over the 1st then the second.

From the trench in rear of the hedge, shots are fired. They lie down and under the reflections, they look for the dark hole of the listening post. . .

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The shots from the small German trench of the hedge determines the attack for the squad on the right which throws grenades and brings on the combat.

The squad on the left follows its course to attack this small trench on reverse side. Many illuminating cartridges are fired from the enemy trench and by aid of this light the officer sees the dark hole of the listening post. He rushes forward with his squad and circling the L. P. each man throws 5 or 6 grenades. They jump into the trench; two bodies are found, 1 dead, 1 wounded. Between these two, one man is kneeling with him arms raised crying "Comrades, Comrades."

The officer rushes to the hedge, finds four dead, in the support trench 6 escape back to the first German line.

But the firing becomes intense, illuminating cartridges brighten this obscurity. Mission is accomplished.

2. Blasts of the whistle, then they take back the prisoner and the wounded one. A rear guard of three men with a lieutenant in command covers the retreat, which is made at double time followed by the firing of two machine guns M-1 and M-2 without difficulty. Return at 4:15 A. M.

Results.—2 prisoners. No casualties. No wounded. Surprise of enemy who could not make the machine gun M-1 M-2 work quicker. Very efficacious and very precise action on the part of the artillery barrage made possible on account of the distance which separated the conquered trench from attacked listening post.

ILLUSTRATION III.

Raid executed by small units of the 22nd Infantry (October 1916). (Bois Chenat, Woevre). Fig. 80).

Mission.—To capture enemy's listening post; take back prisoners.

Effective Raid.—One officer commanding the raid, one sergeant, two bombing squads supported by the fires of one battery of the rifle grenade (4 tromblons).

Ammunition.—Each grenadier is armed with an automatic pistol, a trench knife and 10 grenades. The battery of R. G. placed in night posts of the second section has 80 shells. No rifles.

Division.—After careful study of the terrain and plans, the officer tells each group its mission.

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1. The first group of bombers form two different groups.

(a) The group on the left in charge of a sergeant will leave at 10 P. M. single file and will surround the small post at 25 yards., then facing the enemy trench, will attack the section between A and B.

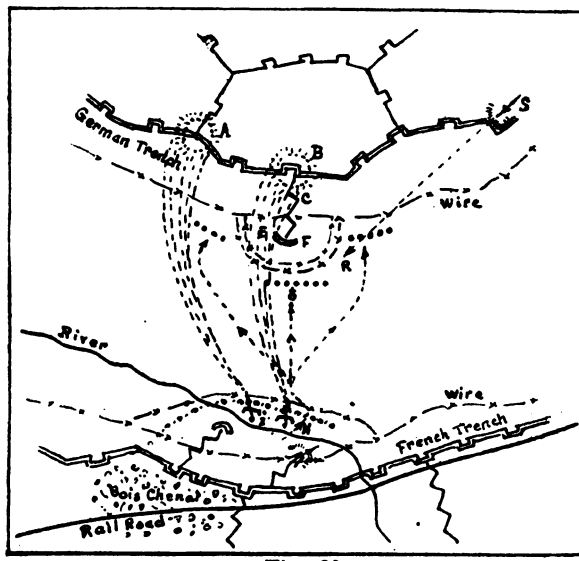

Fig. 80.

(b) The group on the right, in charge of a corporal, will leave at 10 P. M. in single file, then will surround the small post at 25 yds.; the two men facing the communicating trench will attack this trench, the other two and corporad will face the enemy trench, and attack the section of the trench to the right of point B.

These two groups will start firing only after hearing the first sound of the second squad.

Each grenadier will throw his 10 grenades at the indicated place, while the second squad will fulfill orders on the L. P.

The second squad under orders of the commander of the raid will start at 10:10 will approach this listening post. Arriving

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at the required distance, the grenadiers will throw five grenades into the listening post E F leaping into the trench and take back the prisoners, wounded or dead.

The battery of R. G. composed of men occupying the night post of the second section, 4 tromblons, 4 aids in charge of the post sergeant.

The two R. G. I. attack the point A (Concentration fire).

The two R. G. H. attack the point B (Concentration fire).

The firing will start immediately after the first sound of the grenades. The fire must be concentrated speedily. Each R. G. throws 20 shells.

Preparation.—1. During two nights the squads detailed to effect the raid sent out patrols to study the positions and to find out the sites of their atacks, each group with its leader.

2. Two trench mortars 58's, fired upon the wire entanglements which surrounds the small post in order to destroy them.

The destruction was controlled from observation post.

3. The machine guns began a harrassing fire at sunset near the listening post to keep them from repairing the wire entanglements, and then continues intermittantly until the hour designated for the operation, 10 o'clock at night.

4. Distance between two enemy lines 150 yds. distance from listening post to enemy trench 50 yds.

5. Arrows indicate the slight skirmishes in the wire entanglements.

6. Return:

(a) Second squad 10:40 P. M.

(b) Two groups 10:50 P. M. End of operations. No casualties. Three prisoners; two of which were slightly wounded, one killed. Surprise of the enemy who opened fire with machine gun in direction of S.R. at 10:45 P. M,

ILLUSTRATION IV.

1. Attack by the A Battalion A. I. F. (Night of 29th-30 August, 1916). (Fig. 81).

1. **Orders.**—The line CD, CF was the objective for a company holding the line A B.

We had a block at V, the enemy having blocks at W and X in the same trench.

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One section of the regimental bombing platoon was ordered to work along the trench to the objective and to establish a block on the other side of it. A second battalion was ordered to follow in close support and a Stokes at T was ordered to co-operate. Company bombing sections were to follow the second wave of their company to deal with enemy dugouts and to clear up generally.

2. **Narrative.**—The first bombing section moved up to block V, and the second wave, moving into No Man's Land, commenced bombing along the trench.

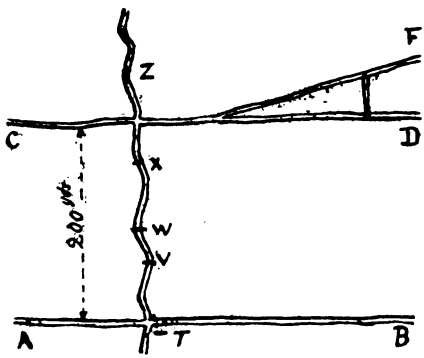

Fig. 81.

They passed the first enemy block (W) and were halfway to the second (X) when the assault was delivered by the first wave. From then to the first objevtice very little opposition was encountered.

On arriving at an intersection of trench V W Xwith trench C D they were assailed with bombs on their right and left from this latter trench, and also from Z, where enemy had established another block.

The trench mortar, being quickly informed, opened fire on Z.

The second bombing section was ordered to deal with the enemy's bombers on the right and left, while the first bombing section continued the advance under cover of the trench mortar, which increased its range about 15 yards every 3 shots.

Z was passed and a block established about 20 yards on the other side of it.

3. **Remarks.**—The total caualties of the two bombing sections were 6 wounded, whilst 10 of the enemy were found dead in the trench V W X Z.

The system of replacing casualties worked satisfactorily.

The bombers had no difficulty in following up the trench mortar fire.

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ILLUSTRATION V.

Attack by the — Battalion. Worcestershire Regiment (24th August, 1916). (Fig. 82).

1. This Battalion in conjunction with — Battalion Wilts Regiment carried out a successful attack on the Hindenburg trench. The right company was given special instructions to guard its right flank.

2. The objective was reached without much difficulty. Two squads of bombers, each consisting of 10 men, including two Mills rifle bombers were then ordered to hold point X, and, if possible, push on to Y, supported by a Lewis gun.

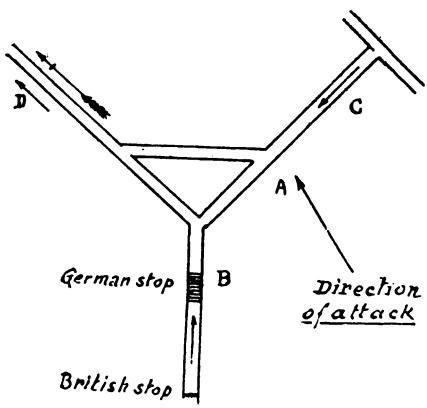

Fig. 82.

At point X a party of six enemy bombers was encountered and driven back by two bombers after an encounter of a few seconds. Two bays behind them a party of 12 to 15 bombers was discovered; it stood its ground. It was evidently covering a machine-gun team, which was seen to be trying to mount a machine gun. This opposition was dealt with as follows:

(a) Riflemen were at once thrown out on either flank in shell holes, well out of bombing range.

(b) A Lewis gun was brought into action on top of a high traverse, enfilading the whole enemy trench, and immediately putting the enemy's machine gun out of action.

(c) A bombing squad attacked the enemy as follows: One officer with periscope (who also threw bombs), three bombers, each carrying 16 bombs and a man with an artillery flag.

(d) A Stokes mortar fired on point Y throughout the operation.

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After about 15 minutes' fighting the entire trench was captured and 23 prisoners taken. We suffered no casualties from the enemy's bombs.

3. The success of the opreation was due to the following facts:

(a) The promptitude with which the Lewis gun and snipers got into position, thereby preventing the enemy from throwing his bombs to the best advantage, while our men outthrew him throughout.

(b) The composition of the bombing team prevented crowding, thereby obviating casualties and indiscriminate throwing.

The use of the periscope rendered the employment of bayonet men unnecessary and made it possible to observe each bomber's individual aim.

The artillery flag, though disclosing our position, was most necessary as a guide to the sniper, Lewis gun, and trench mortar battery.

(c A few smoke bombs were carried, and two of the four dugouts found had to be burned out, as Germans were found coming out of them after the bombing party had passed and showed fight.

(d) The Stokes gun kept up an accurate fire on Point Y, and thereby probably prevented the retirement of the Germans who were captured.

No Mills rifle grenades were used, as our men successfully outthrew the enemy with hand grenades.

The battalion made a successful attack on a German strong point and bombed up the trench to the north of it.

The attack was made about midnight; during the day our artillery and Stokes mortars had shelled the strong point. This was V shaped, vide sketch.

Two platoons were directed to attack across the open (A on sketch), and bombing parties to bomb up the trench on either side (B and C on sketch), and to joint up with them.

Immediately before the assault the strong point was bombarded for a few minutes with rifle grenades. The enterprise was carefully timed and each party reached its objective simultaneously and soon joined hands.

A considerable number of Germans were found in the deep dugouts and taken prisoners. Others ran up the trench (D on sketch), followed by our bombers, who killed several and

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took more prisoners; but finding they had pushed beyond their objective and that the enemy were rallying and trying to surround them they retired to the bomb stop which was being made as the prearranged objective. As but little opposition was at first met with the bombing parties pushed on very quickly.

Branching off to the right and left were a large number of deep dugouts and trenches, and after finding "stops" over each dugout bombing teams for each branch trench and working parties to make barricades few men were left when the final objective was reached—where the most resistance was experienced. It was found more satisfactory to attack by daylight than by night, owing to the difficulty of seeing where the various dugouts and branch trenches led to.

ILLUSTRATION VI.

Raid Executed by units of the 162nd French Division. (June 21st, 1917). (Fig. 83).—By Capt. Ullern.

I. MISSION.

To carry trenchee de Feensburg and trenchee Blonde between Mont Cornillet and Mont Blond, trenches whence the enemy could observe our positions south of Mont Cornillet.

II. RECONNAISSANCE.

After conference with the C. O., commanding the 132nd Division, and after having thoroughly examind the pohtos of the enemy's position. The C. O. detailing a minute reconnaissance of the terrain lieutenant d' Hauteville and sergeant bombers Portat and Pellerin. This reconnaissance was executed on the evening of June 19th, and continued on the morning of June 20th. It enabled me to determine exactly the emplacements of the enemy's barricades, and to fix very precisely the approaches for the attack, together with the plan of operations for the party. This plan was outlined after having secured the advice of the Colonel commanding the 166th infantry regiment, in command of the sector, and was approved by the G. O. commanding the Division.

The attack had at first been decided for June 20th. at 21 o'clock (9:00 P. M.); it had to be postponed to June 21st, 3:50 A. M. for the following reasons:

1. Necessity to ensure the support of machine guns, autorifles and 37 guns whose role is necessarily less accurate at night.

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2. Insufficiency of the stock of grenades necessary for the fight. This stock, owing to the heavy bombardment from the enemy, could not be completed at night, and only thanks to to the energy of the reserve battalion of the 166th. Not withstanding an extreme fatigue, this battalion fulfilled this strenuous task rapidly.

3. Greater facility of observing the movements and counter-attacks of the enemy, following the combat.

4. Possibility of taking advantage of the darkness by taking advantage of the darkness for getting closer to the enemy, and thus engaging the grenades fight at a better range.

III. PLAN OF ATTACK.

Effectives.—The effectives engaged for this operation included:

(a) One party thus composed:

6 Section of bombers (48 men and non-com's).

3 sections of auto-riflemen (24 men).

1 platoon of 16 bombers from the Divisional Depot of the 132nd Division.

These elements had to fulfill the offensive operation itself.

(b) 5 platoons of infantry of the 166th and 20 ammunition-carriers, who had to ensure the replenishment of the bombers and the occupation of the ground conquered.

(c) A working party, strong 10 men, furnished with tools necessary for connecting immediately the position conquered to the departure trench.

Distribution of the Troops.

Five assaulting columns constituted out of the above detachments.

1. One column under the command of second lieutenant Aligne, including:

2 section of bombers.

1 platoon of infantry (3rd Co.)

The mission of this column was to carry the enemy's barricades of the aEstern part of trenchee de Flensburg, the point R, the approach trench R. O., and at last the point O.

2. One column under the command of second lieutenant Leger, including:

2 section of bombers.

1 platoon of infantry (32nd Co.)

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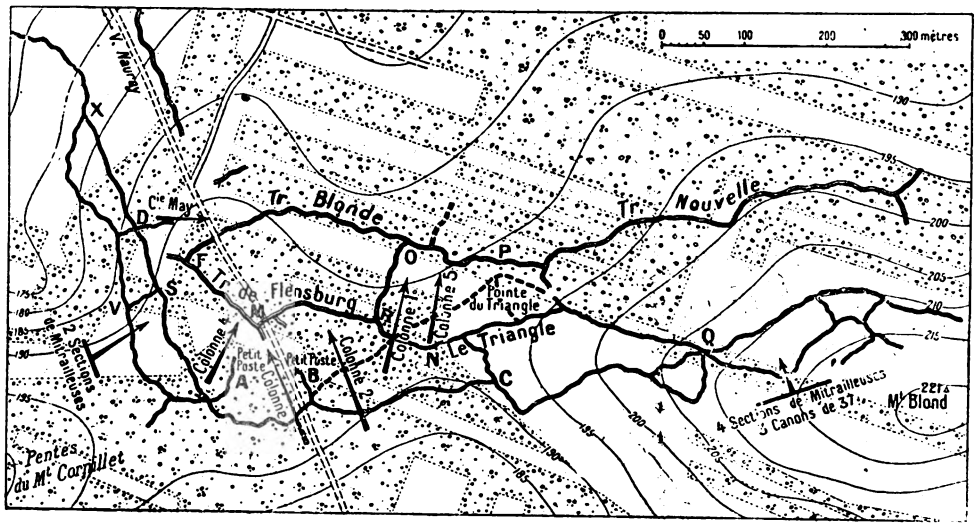

Fig. 83 Sketch of the ground and position where raid was made.

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The mission of this column was to carry the trench RM as soon as point R will have been carried by the first column.

These two columns were to operate under the protection of a section of auto-riflemen, located at the points du triangle (apex of the triangle), and firing at R O and O P. Both were under the orders of first lieutenant grenadier d'Hauteville, who was also charged with their replenishment.

3. One column under the command of sergeant Langeron, including:

1 section of bombers.

1 platoon of infantry (3rd Co.)

The mission of this column was to attack point M, starting from outpost B, as soon as the second column will have made sufficient progress in R M. It is suported by one platoon of auto-riflemen located in out-post B, and firing in the direction of Trench R M.

4. One column under the command of sergeant Borel, including:

1 section of bombers.

1 platoon of infantry (3rd Co.)

The mission of this column was as follows: Starting from outpost A, attack, in liaison with the third column, the trench left of point M; progress in trench M F and carry point F.

It is supported by a section of auto-riflemen located in A and firing on M F.

5. One column under the command of second lieutenant Mangin, of the 166th, including.

1 platoon of bombers of the 132nd Division.

1 platoon of infantry (7th Co.)

The mission of this column was to take hold of the trench P O. It is to launch its attack, as soon as point R is carried, and as the first column advances in R O.

Columns 3 and 4 were in charge of the C. O. of the raid.

SUPPORT FROM THE NEIGHBORING ELEMENTS.

4 sections of machine guns, and 3 37 guns, located on the N. W. slope of Mont Blond, held under their fire R O the trenchee Blonde and the ground North of this trench.

2 sections of machine guns, located on the eastern slopes of Mont Cornillet, crossing their fire with the section of Mont Blond.

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1 section of rifle grenadiers of the 166th, located in trench X, fire on trench F M R, later on Trenchee Blonde, as soon as trench F M R is carried.

1 platoon of Antoine May's Co. of the 366th who had dug an approach trench in the direction of Trenchee Blonde, was to go forward and join the bombers, as soon as the

The artillery, advised in advance, was to put down on special demand by rocket, a fixed barrage in front of Trenchee Blonde and on Trenchee Nouvelle.

GRENADES—AMMUNITION.—Supplied from four dumps, containing:

1. At the pointe du triangle, 3000 hand grenades (including 500 A. B. (incendiary grenades), and 2,000 V. B. grenades. progress of this place would seem sufficient.

2. In A— 2000 hand grenades (including 100 A. B.) and 2000 V. B. Grenades.

4. In C—Emergency dumps containing excess brought up at night by carrying parties.

The supplies in these different emplacements are verified during the night from the 20t0h to the 2st by sergeant grenadier Portat.

IV. EXECUTION.

The detachment of bombers and auto-riflemen was during the evening of the 20th, gathered in a dug-out.

The barricade in the trench between R and N having been attacked in the morning with hand grenades, and held by the bombers of the 166th, a section of bombers from an attacking party moved up close by this barricade, in order to relieve the tired group of the 166th, and to hamper any new attack from the enemy. At 22 o'clock (10:10 P. M.) the Germans did attack this barricade, but were easily repelled with incendiary grenades.

The other sections left their shelter on the 21st at 1 o'clock and reached their departure-emplacements where the columns were constituted as above. At 3 o'clock, the Germans launched a heavy attack with incendiary grenades against the barricade in trench R M. This attack is swiftly broken down by grenade fire from the front sections of bombers, belonging to columns 1 and 2. During the fight, second lieutenant Aligne and noncom's Garnier and Pellerin are badly wounded by phosphorous burns, but stick to their posts.

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At zero hour (3:30) while the struggle is still in progress around this barricade, second lieutenant Aligne, showing the finest energy, and gallantly supported by non-com's Garnier and Pellerin, dashes forward, followed by the first two columns. This heavy blow throws the enemy back, but he does not cease fighting with grenades. Several times, he endeavors to stop our advance ;always outranged by our bombers, and severely struck by our grenades, he is compelled to continue, and even to hasten his withdrawal.

At the same time, the fifth column (Lieutenant Mangin) has also overthrown the enemy, notwithstanding two counter-attacks delivered by the enemy from the Tranchee Nouvelle, who endeavor to attack it on its flank, this column continues its advance.

About 4 o'clock, the columns of lieutenant Aligne and Mangin join at point O. During these combats, the section of auto-riflemen of sergeant Boutrouille which had moved forward and had taken position in shell-craters, has given great assistance in repulsing two counter attacks launched against lieutenant Mangin's column.

As soon as the first column occupies point R, the second column engages the fight, and advances in R M. Unfortunately, the replenishment being very strenuous over ground soaked with water and considerably torn up with shells, swept by the continuous fire of machine guns located in M, the parties of the 166th detailed to replenishment, worn out by the fatigues of the preceding days, can not keep this column sufficiently furnished with grenades. The fight slackens a few minutes at this point, and our bombers drop back, in order to secure more ammunition. Lieutenant d' Hauteville comprehending the situation, immediately appeals to other ammunition carriers, taken from another company of the 166th. and succeeds in quickly re-establishing the chain of replenishment. At this moment, second lieutenant Aligne, who's column had finished its task, takes the command of this column; the fight is resumed and the advance continued.

When I saw the group Aligne approaching point A, the C. O. of the raid launched the attack of columns 3 and 4, who had been, until this moment, busy with firing hand and rifle grenades at the enemy's trench, right and left, from point M. This fire had even succeeded in destroying entirely the personel of two machine guns located close to point M.

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The attack of these last two columns was carried with an overwhelming dash by the men, impatient to go ahead. The enemy was thereby panic stricken. The Germans, leaving their trenches, fled to all sides, pursued by the grenadiers and by the men of the 166th, who's enthusiasm was indescribable, and who, standing on the parapets, fired at the fugitives. The carriers themselves, forgetting their fatigue picked up rifles abandoned by the enemy and started shooting at him. .

During this disorderly retreat on open ground, the enemy, taken under the fire of machine guns, 37 guns, and even under the barrage of our artillery, immediately launched, certainly suffered very heavy losses. His fugitive groups could be watched vanishing little by little; but very few elements reached Nauroywood.

On the conquered ground, a few small isolated groups still offered resistance. The bombers swiftly got rid of them. During the attack of one of the latter groups, second lieutenant Aligne was wounded by a bullet in the chest; he nevertheless kept on encouraging his men, and only left the place on formal order of C. O. of the raid, the attack being besides entirely at an end.

Consolidation.—On demand of the C. O. of the raid. a section of machine guns took up a position first in M and later in F. The working party, as soon as the third and fourth columns crossed the line M F, boldly got on the open ground and dug an approach trench, connecting outpost B with conquered trench.

Reaction of the Enemy.—During the attack, a very heavy barrage of 105 mm. and 150 mm. guns was put down on our first line trench, and on the approaching trenches leading to it.

Two counter attacks were attempted debouching from the Trenchée Nouvelle, which were repulsed as stated. Over 200 corpses were counted by the 166th on the conquered ground. To these losses must be added those suffered by the enemy during his retreat. Besides, 6 light machine guns were taken. 5 prisoners were captured by the attacking forces; 10 more by the company May of the 366th, who's help has been very efficient.

The answers of these prisoners have enabled us to know that the enemy's forces against which we fought, amounted to one battalion, very heavily burdened by the previous attacks, and two fresh companies ,especially called up in order to execute the attack launched by the enemy at 3 o'clock, having for its objective the Tranchee de Flensburg. The action

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seemed so severe to the enemy, that he feared for a while a very far-reaching action.

CONCLUSION.

The dash and eagerness of the bomber groups have been quite remarkable; the help given by the men from the 166th, especially by the 3rd Company (Captain Gallais), has greatly contributed to the success; a large part of it is due to them. These men, tired by a sojourn from the trenches, in an especially difficult sector, have fulfilled their tack with an energy above all praise.

The liaison between all arms has been perfect; the help machine guns, auto-riflemen, one-pounder guns, has been most efficient. .

Expenditure of Grenades.—About 10,000 hand and rifle grenades have been spent. This number shows all the importance of the replenishment in an operation of this kind. . It is necessary for the officer in command, to detail a very energetic officer to this replenishment.

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APPENDIX III.

Rules Concerning the Execution of Tests for Appointments as Bombers.

At the completion of the individual training period company commanders will apply the following tests to determine the fitness of the men for appointment of bombers:

First Test.

Eliminating; object, verification of accuracy in throwing.

1. **On open ground.**—Throw 10 dummy grenades to each distance.

Position: Standing, 35 yards, kneeling, 25 yards; prone, 15 yards.

Objective :Trench 1 yard wide, 1 yard deep, and 3 yards long.

Requirements: Not less than 50 per cent. of hits.

2. **From a trench.**—Throw 10 grenades, plunging fire.

Position: Any; throwing trench 6 feet deep.

Objective: Trench 1 yard wide, 1 yard deep, and 3 yards long; distance, 30 yards; objective not seen by thrower.

Requirements: Not less than 50 per cent. of hits.

3. **Over traverses.**—Throw 12 grenades in a fire trench.

Position: Standing.

Objective: First 6 grenades over 1 traverse; then 6, over 2 traverses; trench 6 feet deep, 3 feet wide; traverses 6 feet high, 9 feet wide, and 25 feet apart.

Requirements: 5 hits out of each series of 6 throws.

Second Test.

1. **Observing.**—The men work in pairs, one throwing and the other observing; 10 dummy hand grenades are thrown, inaccurately at trenches, at distances up to 30 yards. The observer, using periscope, announces the correction after each throw.

Requirement: The observer's corrections after each throw must be such that the next grenade if thrown as directed, would strike in the objective trench.

2. **Knowledge of mechanism of grenades.**—Take apart one grenade of each service model; ask 6 questions of the characteristics of grenades, detonators, fuses, and primers; 6 ques-

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tions on the care and preservation supply and handling of grenades; 6 questions of grenade fighting.

Requirement: Not less than 50 per cent of correct answers.

3. **Throwing exercises as in paragraph 2 of the first test, but using live grenades.**—Throw 6 grenades.

Requirement: Not less than 50 per cent, of hits.

To qualify as a bomber the candidate must make a general average of not less than 65 per cent. on the entire examination. The first test, which is elementary, may be repeated; a second failure resulting in sending the candidate back to the instruction squad.

The candidate for "expert bomber" must have qualified and have the rating of bomber, and must successfully pass an examination consisting of 10 questions on each of the four subjects prescribed in the special course for "expert bombers," with an average of not less than 65 per cent. In addition to this he must, in the opinion of the examining board, have the necessary physical and mental qualities to successfully perform the responsible duties of "expert bomber."

Bombers and expert bombers should wear a special chevron denoting their rank, and receive extra pay on the basis prescribed for similar qualifications in small-arm practice.

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APPENDIX IV.

EXPLOSIVES AND FIREWORKS.

SUMMARY SUGGESTIONS.

I. EXPLOSIVES.

1. **Composition.**—Explosives are composed of combustible stuffs mixed or chemically combined with oxidizing substances, that is to say, rich in oxygen.

These oxidizing substances allow the combustibles to burn quickly and in closed vessels. Oxygen is obtained by:

1. Mixture with combustible, of chlorate or nitrate.

2. By molecules of peroxide of nitrate chemically prepared with the molecules of an organic composition.

2. **Classification.**—Two large classes are derived from:

1. Mixed powders whose component parts are:

(a) Nitrated powder, (chiefly nitrate).

(b) Chlorated powders, (chiefly nitrate).

(c) Perchlorated powders, (chiefly nitrate).

II. Chemically prepared powders whose component parts are:

(a) Powders, chief element is cellulose. (gun cotton).

(b) Powders, chief element is glycerin, (nitro-glycerin).

(c) Powders, chief element is carbide of hydrogen (Benzol, Phonel, nitrated napthol).

3. **Characteristics.**—A good explosive must be:

(1). Stable as to its constitution and characteristics for a long period.

(2). Uneffected by ordinary variations of temperature and moisture.

(3). Insensitive to shocks of handling transportation, projectile, and neighboring explosives.

(4). Not too difficult of detonation.

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(5). Quick enough to give good results when not confined and slow enough to give good results when confined.

(6). Convenient in form and consistency for packing and loading and for making up charges of different weights.

The third and fourth of the above requirements are antagonistic and must be compromised.

General Nomenclature.—

(A) MIXED POWDERS

(a) Nitrated Powders.

1. **Ammonal.**—(Shills British grenades explosive). An excellent explosive, and non-sensitive to shocks. Largely used in British Army.

It is one of the most powerful explosives known, and has, in a high degree many of the most important requisites for military use.

Its composition is:

Nitrate of Ammonium	70%
Aluminum Powder	25%
Charcoal Powder	5%

Good fragmentation, gives little smoke, and offers good resistance to dampness. Is detonated by the aid of a wave explosive and does not light only at a high temperature.

2. German "ovides" grenade explosives.

Its composition is:

Black powder	65.8%
Byryta nitrate	8.9%
Perchlorate of Potassium	20.8%
Aluminium powder	4.5%

The chlorate mixture is decomposed by the wave explosive, which produces this black powder, and forms several charges of petards in line connected by detonating fuses. The powder lights by mere contact with a body in ignition and thus does away with the fuse of a detonator.

3. **Explosives for Cylindrical hand grenades with handle and German rifle grenade. (1913 and 1914).**

Composed of—

Nitrate of ammonia	78%
Trinitrotoluol (T. N. T.)	15%
Dynamite	7%

The two latter bodies increase the explosive power of the former.

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Explosive is very sensitive to shock, sensitive to low temperature, detonates by aid of wave explosive.

(b) **Chlorated Powders.**

Chlorates used are in general, potassium chlorates, sometimes sodium chlorates. Explosives most frequently used are the "cheddites." In these explosives the chlorate is rendered less sensitive to shocks by enveloping same in a greasy animal or vegetable matter, previously colored, and a nitrated derivative is sometimes added.

Cheddites are sensitive:

1. To dampness.
2. To high temperature.
3. To violent shocks.

They light, causing small flames, without detonating, but detonate violently if they are pulled up. (i.e. La Pallice Catastrophe).

Do not affect metals and detonate under the influence of wave explosives.

There are two cheddites in use in France.

One is composed of:

Mononitronaphtalene	12%
Castor Oil	8%
Chlorate of potassium	80%

The Other is composed of:

Chlorate of potassium	90%
Vaseline	3%
Glycerine or palaffine	7%

The latter is the most popular and more commonly used, for loading French grenades on account of its facility of fabrication, and its inexpensiveness.

Cheddites detonate very poorly if piled up.

Germans use for the loading of their "Lenticular grenade" an explosives which is similar to a French paraffined cheddite.

Composed of:

Chlorate of potassium	78%
Dinitrotolene	10%
Paraffine	12%

In more recent fabrication of grenades paraffine has been substituted by sawdust.

Chlorate of potassium	72.5%
Trinitrotolene	18.5%
Sawdust	8.7%

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(C). Perchlorated Powders.

Of these mixtures, the most frequently used is what is called a "blue explosive."

Very popularly used for loading bombs or trench mortars "58."

Composed of:

Amonia perchlorate	61.5%
Chile Saltpeter	30%
Paraffine	8.5%

Other chlorate explosives exist, but we will mention only those for loading of machines for warfare.

(B) Chemically Prepared Powders

(a) **Organic nitrated substances.**

1. **Nitro-cellulose,** (Cotton Powder in French; Gun Cotton in U. S.

Above is obtained by treating the cotton cellulose with nitric acid.

In appearance resembles cotton. Burns instantaneously in exposed atmosphere leaving no residue. When dry it detonates very easily by shock. Is unstable and constantly decomposing.

All modern smokeless powders are chiefly composed of nitro-cellulose. They have been made consistent, rendered less sensitive to shocks, and do not break up when mixing nitro-cellulose with the gelatin.

Nitro-celloses used are divided into 3 classes. Their degree of nitrification is:

C. P., C. P. I., or C. P. 2, (Designating Cotton Powder)..

The French (B) powder is made of C. P., dissolved in a mixture of sulphuric ether, alcohol and non-dissolvable C. P. 2.

German powder is a mixture of C. P. 1, and C. P. 2, both dissolved in acetic ether.

British, American and Italian powders are a mixture of C. P. I. and C. P. 2, and nitro-glycerin dissolved in acetone.

These powders resist shocks and are less sensitive to dampness than black powders.

They light in exposed atmosphere without detonating, giving off little smoke and leaving little residue.

They detonate in enclosed vessels.

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2. **Nitro-Glycerine.**

Obtained by treating glycerin with nitric acid.

Detonate by shock and is very inconsistent. It fuzes at high temperature.

To utilize same, it has to be absorbed by a porous material. Either inactive, sand or broken brick.

Or active, pitch, rosin, nitro-cellulose, nitrates.

Dynamite.—Dynamite consists of a grannular ball usually called dope in the trade, partly saturated with nitro-glycerin. Dynamites are classed according to the percentage by weight of the nitro-glycerin contained at 75% dynamite, 60% dynamite, etc.

The dope may be an inert substance having no function except as a vehicle for the glycerin or it may be, and usaully is, a combustible substance contributing to the chemical reaction and improving the strength and character of the explosion. Dopes of this kind are usually nitrate of rodium or potassium. All American dynamites are of this class.

(b) **Carbide of nitrated hydrogen.**

Carbide hydrogen, extracted from oiled tar by distillation (phenol and benzol) treated by nitric acid, gives a whole series of explosives.

Most frequent in use are picric acid and trinitrotoluene

1. **Melinite. (Picric Acid).**

Does not detonate easily by shock, but detonates at the speed of 7600 yards per second under the influence of corrugated explosive, and the breaking effects are very considerable.

2. **Triton or Trinitrotoluene or Trinitrotoluol or Trotyl.**

Resists more to shock than melinite. Is advantageous to melinite in that when coming in contact with metals it does form picrates which are resistive to shock.

Known in France as "Tolite." Called T. N. T. in America.

American grenades are loaded with T. N. T.

Is made by the successive nitration of toluene and coal tar derivative. It is a neutral compound, very stable of great strength, yet highly insensitible.

3. **Jovite.**—An American powder of this class seems to come as near meeting all military requirements as any explosive now known. It is unaffected by heat, cold, concussion,

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or water. The gases of explosion are less deleterious than those of dynamite and produce no headaches.

Jovite may be had of strength equal to 20, 40 and 60% dynamite.

Note.—Nevertheless the most successful military explosives thus far introduced belongs in this class picric powders, for example, the French melinite, the English lyddite, the American Triton or Trotyl or T. N. T., the Austrian ecrasite, the Japanese Shinose, and others.

C. BLACK POWDER.

The series end by mention of black powder composed of:

Coal	2.5%
Saltpeter	75%
Sulphur	12.5%

Very consistent and regular.

Its rapidity of combustion is universally proportional, according to size of grains. No breaking power, giving only mechanical results only well rammed Black powder was used for loading French and German spherical grenades, which grenades no longer existt.

II. FIREWORKS.*

(Generic term for primers, fuse, detonators and any pyrotechnic means of communicating fire).

To ignite an explosive, that is to say to produce a decomposition, parts of it must be raised at a fixed temperature.

This is done:

I. By lighting a part of the explosive and favor the elevation of the temperature and the pressure of ramming.

II. Or by a shock. The shaking brought about by the shock on the molecules decomposes them and they then explode. Their explosion gives a shock to the neighboring molecules and the phenomena continues.

The explosion spreads at various speeds, according to the explosives. This speed is called "corrugated or wave explosive."

Shock can be brought about mechanically or by an explosive.

The artifices are set in motion by means of a lighter composed of fulminate of mercury. This lighter is called the

*Or artifices.

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fulminate lighter or **detonator.** Fire is carried to the detonator by a time fuse, being lit by an igniter.

The detonator may be ignited by shock, the shock being given by a percussion plug.

1. **Detonation.**—A brass tube filled with the following composition:

Fulminate of mercury	O gr 3
Pulverised Melinite	O gr 3
Compressed Melinite	O gr 3

Fulminate is very sensitive to shock, the slightest friction causes it to detonate. It detonates at a comparatively low temperature (348 degrees F.)

Breaks easily.—Fulminate must be handled with exceptional care and precaution.

2. **Bickford** or **Safety fuse** is used to ignite the fulminate. It consists of a powder thread wrapped with a waterproof tape, a double wrapping or double tape preferred. This fuse may be used in wet holes, but for under water use it should have a continuous rubber coating.

Time fuse burns at an average rate of 3 ft. per minute, but the rate is not regular and when time is important the rate of burning should be tested.

3. **Igniters.**—The fuse is lit either by direct contact of a burning body, by lighter, or by the Ruggieri igniter, tension or rotation method.

All igniters contain a certain amount of fulminate of mercury, a body, designed to cause this fulminate to light (broken glass) either by friction and by help of a black gun powder to transmit the fire.

4. **Percussion Plug.**—When the detonator is put into action by shock, a metallic pointed stem is attached to the end of the fulminate, and can be violently thrown on the fulminate when the time arrives to cause the lighting of the detonator.

6. **Detonating Cord.**—This cord is a lead tube about 0.2 of an inch in diameter, filled with triton. The cord can not be set off by friction, fire, or any ordinary shock. It requires a blasting cap properly attached to it to detonate it but when it is once set off the explosive wave travels throughout its length with such rapidity (6500 yards per second) as to be practically instantaneous. Such extreme care is necessary to obtain success

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with this cord that it is of doubtful value for hasty demolition. The French use a cord with a melinite core and tin casing. Its rate of burning is said to be 7,600 yards per second.

7. **Connection.**—To attach a detonator to a detonating cord, the end of the cord is squarely cut off. Union is attached by slipping the cord into the end of the unions opposite the slit and crimping. The blasting cap or electric fan is then inserted into the split end until it butts against the cord, when the slip ring is pushed tightly into place. A space one-eighth of an inch between the detonating cord and twisting the split ends around the trunk, one to the right and the other to the left. The joint may be wound with electric tape. Remember that it is the branch that is to be split and twisted and not the main. Lead the branch away from the main at right angles for an inch or two.

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